DOCUMENT RESUME

ED 134 402 SE 021 380

AUTHOR Hill, Berton F., Ed.
TITLE Abstract Reports, Student-Originated Studies Projects, 1974.
INSTITUTION National Science Foundation, Washington, D.C.
REPORT NO NSF-75-38
PUB DATE 74
NOTE 474p.; Presented at the Project Reporting Meeting (Washington, D.C. December 26-28, 1974); For the 1973 Report, see ED 100 708; Best copy available
AVAILABLE FROM Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock Number 038-000-00247-3, $5.20)

EDRS PRICE MF-$0.83 HC-$24.77 Plus Postage.
DESCRIPTORS Abstracts; *Biological Sciences; *College Science; Environment; Natural Resources; *Physical Sciences; *Research; Rural Areas; *Sciences; *Undergraduate Study; Water Resources
IDENTIFIERS Research Reports

ABSTRACT

This document contains abstracts to 135 student-originated research projects sponsored by the National Science Foundation. Abstracts are grouped under the following categories: (1) General and Environmental Studies; (2) Natural and Resource Studies; (3) Urban and Rural Studies; (4) Water Related Studies. Most projects list the study title, location of the study, duration of the study, student participants, faculty advisor, and an abstract of their work and findings. (RH)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED134402

SE

STUDENT-ORIGINATED STUDIES PROJECTS

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

1974

Abstract Reports

BEST COPY AVAILABLE

Presented at Meetings
in Washington, D.C.
December 26-28, 1974

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

NSF 75-38

NOTICE

The final technical report of each project described herein is distributed, so long as supplies last, by the grantee institution, NOT by the National Science Foundation. Users of this document who require fuller information are advised to inquire of the Student Project Director, in care of the Faculty Project Advisor at the address listed in each individual abstract.

Single copies of the Abstract Reports may be obtained gratis from the Student-Originated Studies Program, Directorate for Science Education, National Science Foundation, Washington, D.C. 20550 while in print. Out-of-print volumes may be ordered through the National Technical Information Service of the U.S. Department of Commerce. (Ordering information will be supplied by the Student-Originated Studies Program upon request.)

STUDENT-ORIGINATED STUDIES PROJECTS

1974

Abstract Reports

Presented at the Project Reporting Meeting
December 26-28, 1974
Washington, D.C.

Edited by BERTON F. HILL

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

Table of Contents

Foreword .... xi.

Section I. (General and Environmental Studies) 1

Immunoadsorption Purification of Rattlesnake Antivenen (Texas A&I University) 2

Behavioral, Biochemical, and Physiological Changes in the Offspring of Chronically Intoxicated Mother Rats (Rice University) 3

Coal Liquefaction: The Hydroreforming of Model Aromatic Compounds and Solvent Refined Coal (University of Alabama) 6

Possible Teratogenic Effects Induced by Pesticides (Central Washington State College) 8

Model Methane Production Process for Wake County, North Carolina (North Carolina State University) 12

The Identification of Man-Made Reservoirs for Human Pathogens in the Human Environment (University of Georgia) 18

Hematological Changes Due to Chemically-Induced Hepatic Tumors in Sprague-Dawley Rats (Maryville College) 21

Biostatistical Methods Applied to Clinical Chemistry and Sports Medicine (CUNY - Hunter College)...........25

Water Factors Affecting Cardiovascular Disease Rates in Three Neighboring Upstate New York Communities (SUNY - State University at Binghamton) 29

The Utilization of Waste Heat for Domestic Purposes (Wesleyan University) 35

Solar Thermal Energy Applications for Home Heating (Sangamon State University) 39

The Diffusion and Dissemination of Computer Technology in the Denver Metropolitan Area (University of Denver).43

Energy: Waco, Texas 1974. Inventory, Household, Energy Patterns, and Citizen Opinions (Baylor University) 47

Development of an Electrical Impedance Plethysmographic Arterial Function Test (Worcester Polytechnic Institute) 49

Actions of Compounds that Act as Post-Irradiation Chemotherapeutic Agents (Austin College) 52

Cleaning Coal with Coal (University of Missouri) 57

Pneumatic Conveyance of Dry Feedlot Manure in an Energy Recovery System (Iowa State University)...... 60

Energy Consumption and Social Interaction in Mobile Home Parks, Champaign County, Illinois (University of Illinois at Urbana) 63

The Design, Construction and Testing of Solar Energy Utilization Devices (Massachusetts Institute of Technology) 66

Neurometabolism of L-Glutamic Acid (Ripon College) 69

An Investigation of the Bacterium, Hydrogenomonas as a Protein Supplement for Animal Consumption (Catholic University) 70

Malnutrition and Brain Function in the Developing Animal (Massachusetts Institute of Technology)......... 76

The Study of the Feasibility of Anaerobic Digestion for Farm Use (University of Wisconsin at Green Bay).... 77

Metabolic and Cardiorespiratory Responses to Wheelchair Ambulation and Walking (Wright State University). 82

The Role of $PGF_{2\alpha}$ in Parturition in the Rat (University of Pennsylvania)........................... 86

Tunable Laser Resonance Raman Spectroscopy of Isorhodopsin (Cornell University)..................... 90

Influences of Hormonal Levels in Females on Intellectual Attitudes and Personality (Central Washington State College)............................ 91

Computer-based Communications Utilities (University of Illinois) 96

High Intensity Noise, Social Behavior, Preferences and Cortisol Levels in Rhesus Monkey (University of Wisconsin, Madison)............................... 100

Behavioral and Physiological Consequences of Sub-Lethal Dosage of Methylmercuric Chloride (California State University, San Francisco).................... 102

Specificity of a Sound Habituation Peptide: Biological and Chemical Assays (Rice University).........103

Effects of Urban Pollutants on Growth of Human Cell Culture (Seton Hall University).....................106

The Effects of Pre-Pubertal Methadone Administration on the Sexual Development and Maturation of the Laboratory Rat (Antioch College)........................110

Section II. (Natural Resource Studies)........................113

Environmental Inventory and Assessment for the John Rigdon Center (Columbus College)...................114

A Study of Fire Ecosystem as it Relates to Vegetation, Soil, Water, Mammal Populations, and Evolutionary Adaptations of the Forest (University of California at Berkeley)...118

An Ecological Study of a Sub-Alpine Cirque Basin (San Jose State University).............................123

Interdisciplinary Approach to the Potential Biological Control of Cockroaches (University of Kansas)...127

Preliminary Population and Behavioral Study of Cetaceans in the Gulf of Maine (College of the Atlantic)...........133

A Survey of Great Blue Heron Rookeries along the Oregon Coast (University of Oregon).......................136

Black Bear Population of the Yosemite Valley and Human-Related Behavior (University of California, Berkeley)..143

An Urban Heritage: The Documentation of the Troy Music Hall (SUNY-State University at Albany)............147

Rural Waste Collection and Disposal in Lincoln Parish, Louisiana (Louisiana Tech University)............149

Post-Fire Successional Patterns in Coniferous Forests of Minnesota (St. Olaf College).................152

Ecological and Biochemical Aspects of Deer Foraging and Forest Regeneration (Harvard University).............156

Tussock Moth Damage as it Relates to Forest Management (Evergreen State College)..................162

The Chemical Basis for the Inhibition of Feeding in Insects (Illinois Institute of Technology).........164

The Detection of Sulphur Dioxide-Induced Injury to Plants by Color Infrared Photography (Marquette University)..167

Levels and Effects of Mercury in Northern Utah (Weber State College) 170

Preliminary Survey of the Plants and Vertebrates of the Wenaha Drainage (Eastern Oregon State College)..172

Missoula Valley Air Pollution Study (University of Montana)...174

Nitrogen-Fixing Properties of Azotobacter relating to Agricultural Supplements (Heidelberg College).......177

Comparative Ecology of Native and Imported Fire Ants (University of Texas at Austin)..................180

The Impact, Ecology, and Behavior of Feral Dogs on Fort Jackson (University of South Carolina)........182

Effects of Atmospheric Alteration on Vegetative Propagation, with Application to Timber Species (Oregon State University)...........................184

Prairie Restoration Experiment in Ohio (Miami University)..186

Population and Habitat of the American Alligator (An Endangered Species) in Texas (Sam Houston State University)..191

Analysis of Aerosolized Pollutants in Feedlots and Other Environments (University of Northern Colorado)...195

Range Rehabilitation in the Midway Watershed Area (New Mexico Institute of Mining and Technology).......198

An Ecological Inventory of Devil's Den State Park (University of Arkansas)............................200

Anasazi Prehistory, Public Lands and Blanding, Utah: A Research Design for Symbiosis (Brigham Young University)..202

Desert Land Use and Management in California -- Its Ecological and Sociological Consequences (University of California at Irvine).............................204

Management of Wastes Created by Removing SO_2 from Industrial Discharges (Bellarmine College).........205

Ecoarcheological Investigations in the Sonoran Biome of Western Nevada (California State College at Stanislaus)...207

Section III. (Urban and Rural Studies).......................209

Neighborhood Resistance to Group Home Establishment in Rhode Island (Brown University)......................210

The Crosslanguage Intelligibility of Phonemes, Sources of Interference in International Voice Communication University of California at Santa Barbara)..............213

North Carolina's Governmental Response to the Energy Crisis (University of North Carolina at Chapel Hill)....218

Therapeutic Effects of a Special Summer Camp Experience of Physically Handicapped Children (University of Virginia)...............................223

Renovating Decaying Urban Areas: An Analysis of Seattle's Pioneer Square Historical District (University of Washington)............................229

Noise and Exit Congestion Related to I-280 in Newark, New Jersey (Newark College of Engineering)......233

Attitudes Toward Education Among Spanish-Americans and Anglo-Americans in a Small New Mexico Town (New Mexico Institute of Mining and Technology).........235

An Environmental Inventory for Urban Planning and Development (University of Northern Iowa)...............242

Land Use Futures for the City of Buffalo (SUNY - State University at Buffalo).....................................246

Modelling and Simulation for the Construction Industry (California State University at Sacramento)....251

Observational Field Study of Adult and Child Interactions (University of Virginia)..................255

Feasibility Study for a Multi-modal Transportation System Serving Florida Technological University (Florida Technological University).....................259

A Study of Urban Crowding in Riverside/San Bernardino, California (University of California, Riverside)........264

Social-Environmental Audit of Colorado Springs, Colorado (Colorado College)..........................269

Interdisciplinary Application and Expansion of the Urban Dynamics Approach to Manchester, New Hampshire (New Hampshire College)..............................273

Hitchhiking--A Viable Addition to a Multimodal Transportation System? (University of Colorado at Denver)...275

Citizen-Community Interaction in Flagstaff, Arizona (Northern Arizona University)........................277

Alternative Futures for San Diego (University of California at San Diego)..............................281

The Energy Crisis and Decision-Making in the Family (CUNY-Herbert H. Lehman College)...............285

The Feasibility of Self-Sufficiency in Consumption of Energy for a Rural College (Marlboro College).......287

Community Attitudes and the Alcoholic Stereotype (Columbus College)....................................289

An Environmental Analysis of the Neshota River Park for Recreational Land-Use Planning (University of Wisconsin - Green Bay)............................290

Marine Parks in Hawaii (University of Hawaii).........294

Land Use in the Sawtooth National Recreation Area (College of Idaho)....................................300

Mathematical Modelling of Noise and Air Pollution at Expanding Ontario International Airport Harvey Mudd College)....................................304

Community Design for Optimal Energy and Resource Utilization (Pennsylvania State University)...........307

Nutrition in Publicly-Supported Institutions (SUNY - State University at Buffalo)..........................312

Benefits of Psychiatric Treatment: Patient, Professional and Community Attitudes (University of Missouri at Kansas City)...313

The Study of Revitalization in an Ethnically Diverse Urban Community (Temple University)..................314

Indian Community Study: The Elderly Indian (University of Oklahoma)...319

Coordination of Social Services, Information Flow. and the Computer (Michigan State University)..........321

Expressway Noise Pollution and Its Psychological Effects on Learning (Thomas More College).............322

The Study of Bilingual Language Acquisition (University of California at Santa Barbara)............323

Alternative Planning Strategies in New Town Development (Northern Illinois University)............326

The Composition of Two Salt Marshes: Human Impacts, Sociological and Political Implications (SUNY- State University at Stony Brook)...........................328

National Policies and Local Environmental Problem Solving: Lane County, Oregon (University of Oregon)....336

Evaluation of the Effects of Noise from Urban Freeways (Western Washington State College)...........338

Planning and Management of Wetlands: Case Study for Middletown, Connecticut (Wesleyan University)......342

Section IV. (Water Related Studies).........................344

Environmental Zinc and Plant Toxicity (Franklin and Marshall College)..................................345

Impact Comparison of Existing and Proposed Sewage Facilities in Two Midwestern Municipalities (Central Missouri State University)............................348

Chemical and Bacterial Water Pollution Indices at Alcorn State University (Alcorn State University)......351

Effects and Possible Improvement of Municipal Storm Sewer Runoff (Northern Illinois University)...........355

The Relationship of Oil Viscosity to Mosquito Larval Death (California State College at Bakersfield)........356

A Limnological Study of Lake Perry with Emphasis on Net Primary Productivity (Benedictine College)......358

Fluoride Levels in an Ecosystem and Related Ecosystemic Changes (Evergreen State College)....................360

The Effects of Agricultural Run-off and Siltation on a New Recreational Lake (Illinois State University).362

An Analysis of Physico-chemical, Microbiological, and Macrobenthic Parameters of Geronimo Creek, Texas (Texas Lutheran College).............................368

Deer Creek: A Resource in Jeopardy (Goucher College)....372

Lobster Aquaculture, Ecology, and Tertiary Sewage Treatment in Controlled Environmental Systems (Woods Hole Oceanographic Institution)..................375

Physical, Chemical, and Biological Analysis of a Disposal Site for Hazardous Waste (University of Oklahoma)...381

Impact of Feedlots on Water Quality of the Upper Iowa River Watershed (Luther College)..................384

Biological, Geological, and Physical-Chemical Parameters of a Southeast Texas Estuary (Lamar University)..386

Mathematical Modelling Applied to Lehigh River Water Quality (Lehigh University)......................390

Application of Modelling and Simulation Techniques to Air Pollution Control Problems (Manhattan College)...394

The Effects of Acid Rainfall on Nitrogen Fixation in Western Washington Coniferous Forests (Evergreen State College)...397

Slag/Slag-Thermal Effects on Hatchability of Pimephales promelas, Brachydanio rerio, Asellus intermedius (Loyola University of Chicago)..........................400

A Comparative Study of Three Central West Virginia Streams, Investigating the Effects of Acid Mine Drainage on Fresh Water Organisms (West Virginia Wesleyan College)......................................402

Mercury in the Benthos of Bellingham Bay, Washington (Western Washington State College)......................406

Baseline Study of Physical, Chemical, Biological and Socio-Economic Parameters of Navarre Beach (University of West Florida)...................................410

Determination of Mercury in Marine Systems and Fishing Communities of Puerto Rico (University of Puerto Rico at Mayaquez).....................................415

Water Quality of Springs and Underground Streams in the Central Kentucky Karst (Western Kentucky University)..418

Comparative Effects of Small Stream Effluents on Red Rock Reservoir Water Quality (Central University of Iowa)..419

Water Quality Enhancement in a Sanitary Landfill Leachate Pond (Lowell Technological Institute)........424

The Cycling of Co, Cu and Ni in a Small, Forested Watershed (Johns Hopkins University)..................429

An Environmental Study of the Vermilion River (University of Southwestern Louisiana)..................434

A Comprehensive Study of the Lower North and South Santee Rivers: A Deltaic Lobe in a Destructive Phase (College of Charleston)..........................440

A Study of the Effects of Zirc Smelter Emissions on the Town of Palmerton, Pennsylvania (Lafayette College)..445

The Effects of Acid Mine Drainage on Lake Hope (Wright State University)............................448

The Effect of Industrial Pollution on the Loosahatchie River Ecosystem (Southwestern at Memphis).............452

Water Quality in the Mid-Hudson Region of the Hudson River (Marist College)...............................455

Utah Lake Plankton Crop Estimation Incorporating ERTS - 1 Imagery (Brigham Young University)...........456

Use of Radiotracer Techniques to Study Ecological and Physiological Behavior of Cadmium (Purdue University)...458

FOREWORD

The 135 abstracts that make up this volume reflect the achievements of the most intensive year of Student-Originated Studies activity to date. In 1974 well over 1,200 student investigators addressed 135 socially relevant problems with the cooperation of 115 different host institutions. The magnitude of the Program's contribution to a better understanding of these problems is significant. It focused upon the selected problems well in excess of a half million hours of scientific labor, at a total cost of just $1.8 million. Even a cursory review of the abstracts will show that these student investigators more than "earned their keep" in collecting and analyzing new data so as to arrive at constructive recommendations for the management of a diverse set of societal problems. For many of these, an unbiased analysis was urgently needed by local decisionmakers. The SOS Program's basic accomplishments, however, will be understood only by realizing that its highly cost-effective production of technical information is a *by-product*.

The most central and lasting result of an SOS experience is to be found in the accelerated scientific development of the individual participants. College teachers report that a substantial majority of SOS "alumni" return to school not only with greatly enhanced laboratory or field skills, but with a new comprehension and respect for the true nature of scientific research, with outlooks and attitudes that come only from first-hand exposure to the twists and turns of a real-life research problem, with a conceptual grasp of the relationships between theory, experimentation and evidence—in short—with a personal, internalized "feel" for what their scientific studies are all about. It is impossible to assess in any absolute terms the value of this sort of a maturational experience in the professional lives of over a thousand young scientists, but that value surely is very great.

[illegible]m confident that the high regard the National Science Foundation feels for the accomplishments of this select group of young people is shared by their associates, their teachers, their parents—by all who take pride and assurance in the industry, intelligence and good sense of America's rising generation.

H. Guyford Stever
Director

Section I.

General and Environmental Studies

Papers from Texas A&I University, Rice University (2), University of Alabama, Central Washington State College (2), North Carolina State University, University of Georgia, Maryville College, CUNY- Hunter College, SUNY - State University at Binghamton, Wesleyan University, Sangamon State University, University of Denver, Baylor University, Worcester Polytechnic Institute, Austin College, University of Missouri, Iowa State University, University of Illinois at Urbana (2), Massachusetts Institute of Technology (2), Ripon College, Catholic University, University of Wisconsin - Green Bay, Wright State University, University of Pennsylvania, Cornell University, University of Wisconsin - Madison, California State University at San Francisco, Seton Hall University, and Antioch College.

Immunoadsorption Purification of Rattlesnake Antivenin

(Grant no. GY-11511)

Texas A&I University
Kingsville, Texas 78363

May 28, 1974 - August 19, 1974

Participants:

Kean Cardwell
Michael Casso
Thelma Garza
Juan Hinojosa
Randy Laurence
Joe H. Martin
Cynthia Owen
Steven H. Rodriguez
Susie G. Smith
Eliseo Valadez*

*Student Project Director

John Carlos Perez, Faculty Advisor

Each year an estimated 2,000 bites are inflicted in the United States by the common pit viper. Of these, the large rattlesnakes of the Southern and Western states inflict the most severe injuries, frequently resulting in permanent damage and occasionally, death.

Currently, there are problems in snakebite treatment for patients sensitized to horse serum. Sensitized individuals cannot receive treatment with horse antivenin because of the risk of anaphylactic shock. The removal of nonspecific antibodies and other proteins from horse serum, through purification, should reduce the risk of anaphylaxis. Purification can be accomplished by the use of an immunoadsorbent.

The group's study was that of perfecting and testing a method of purification of rattlesnake antivenin by immunoadsorption. The use of a gluteraldehyde insolubilized venom as an immunoadsorbent was the key factor for the process. The protein components of the venom were insolubilized with various concentrations of gluteraldehyde. 1.5 ml of 2.5% gluteraldehyde per 1 ml of venom used to insolubilize the venom showed the highest adsorbence of antibody from the gamma globulin fraction. Glycine buffer pH 2.3 was used to elute the specific antivenin antibodies from the insoluble immunoadsorbent.

Reference copy: Department of Biology, Texas A&I University

****

Behavioral, Biochemical, and Physiological Changes in the Offspring of Chronically Intoxicated Mother Rats (Grant no. GY-11458)

Rice University
Houston, Texas 77001

May 20, 1974 - August 9, 1974

Participants:

Gary Brewton	Albert Smith
Tim Cooper	Laura Swigart
Mary Degnan	Dana Tanner
Blinda McClelland	Robert Thomas*
Mark Prendergast	Sue Woodson

*Student Project Director

Kathleen Shive Matthews, Faculty Advisor

Female rats were gavaged with ethanol, wine, or water shortly before mating and throughout gestation. The same mother rats were also divided into two groups, according to diet: regular or deficient (low protein and thiamine deficient). Thus, the offspring studied can be divided into six experimental groups corresponding to their prenatal environment -- good/ethanol, good/wine, good/control, deficient/ethanol, deficient/

wine, deficient/control.

From the time of birth all offspring were treated as identically as possible. Gavaging was stopped, both good and deficient diet mothers were given good diet, and all offspring were weaned at 25 days. Offspring were weighed each of their first 14 days and then every even-numbered day. Weights were rounded to the nearest tenth of a gram. Throughout the first several days of life the control offspring averaged approximately 1 gram heavier than wine or ethanol groups. The ethanol animals weighed the lightest at birth. Control groups averaged more viable offspring per litter. No conclusion could be made concerning the relationship of wine and ethanol in this respect. The deficient diet had obvious detrimental effects on mortality, average viable offspring per litter, and the average birth weight.

During chronic ingestion of alcohol, the activity of the lysosomic, hydrolytic, carbohydrate enzyme, β-glucuronidase, is known to decrease. Activity of this enzyme was studied in the liver lysosome fraction prepared from the offspring at varying ages through their development. Having too few offspring to sacrifice at each age tested, no significant changes in activity can be noted. The activity of carboxypeptidase in whole rat liver homogenate was also studied through the development of the offspring in the different experimental groups. No significant changes in activity can be noted.

The ratio between desmosterol and cholesterol in the brains of the developing offspring was determined, being based on the postulate that differences in the prenatal environment of the experimental offspring could result in different rates of nerve fiber myelination in the brain and that the rates and extent of myelination can be inferred from changes in the desmosterol/cholesterol ratio. Satisfactory results in this experiment were not obtained due to technical difficulties.

A study of the activity of alcohol dehydrogenase, ADH, in the brains of the offspring was undertaken. Because the possibility of detecting and comparing ADH with the assay used proved to be marginal, and because inhibitors and possible activators were observed, efforts were centered on the study of potential activators and inhibitors and their relation to the ages of the rat offspring. No significant differences in the activation or inhibition of ADH could be detected within the limits of error of the assay.

The psychological examination for this investigation consisted of three tests--the visual cliff, a simple left-right discrimination T-maze, and a measure of general activity in an open field situation. Results of the open field test show some sort of qualitative differences in development among the experimental groups. While scores for the control groups appear to have a fairly straight, linear development, the scores for both wine and ethanol are not straight but curved functions with a peak in several cases at 24 days. The visual cliff results indicate that the ethanol rats opened their eyes for the most part one or two days prior to the wine and control group rats. On the other hand, these same ethanol rats appear to lag one day behind control rats in acquiring depth perception. Finally, the T-maze data points generally to poorer performance by the non-control groups.

Reference copy: Fondren Library, Rice University
****

Coal Liquefaction: The Hydroreforming of Model Aromatic Compounds and Solvent Refined Coal (Grant no. GY-11466)

University of Alabama
University, Alabama 35486

May 28, 1974 - August 16, 1974

Participants:

Jimmie Y. Broach
Richard Carlin
Mang Hung Chan
Willie Clements
Karen L. Douglas
Harlan Hiramoto
Richard M. Katz
Allen Lenoir
Joan MacDiarmid
Georgie Stanford
Karen Stone*
James Weems

*Student Project Director

Lowell D. Kispert, Faculty Advisor

Coal consists of polynuclear aromatic and hydroaromatic structures joined together by short aliphatic groups, ether linkages, sulfide and disulphide bonds and biphenyl-type linkages. About 70% of all carbon atoms in coal are in aromatic rings, predominantly six-membered; however, the average number of aromatic nuclei in a cluster is about three. These multi-ringed moieties are solids at room temperature. To liquefy coal involves transforming its molecular structure to a form that contains very few multi-ringed aromatic molecules. Links connecting the aromatic clusters must be broken, and the size of the polynuclear aromatic aggregates must be reduced. These liquefaction processes require a considerable quantity of hydrogen.

The research was aimed at investigating the hydrogenation of Solvent Refined Coal (S.R.C.), a low sulfur, low ash coal, by means of two catalyst systems: (1) acidic molten salt catalysts, and (2) homogeneous transition metal complex catalysts. The experimental approach was the identification of suitable hydrogenation catalysts through experimentation with model compounds representative of those in coal. These catalysts were then applied to S.R.C. samples. Much of the work was necessarily analytical in nature.

The reaction system consisted of a pressure reactor (bomb) containing the reactants, catalysts and hydrogen gas in a heating, rocking autoclave. The system was designed for batch runs in which only initial hydrogen pressure was available for hydrogenation. After a run was completed, the products were worked up by one of several methods. The ideal method was fractionation of the entire product through a packed column followed by vacuum distillation of the high boiling liquids. Then each fraction was analyzed by means of nuclear magnetic resonance (NMR) spectroscopy, gas chromatography (GC) and carbon-hydrogen-nitrogen (C-H-N) analyses. Analyses revealed the amount of liquefaction of products that occurred by indicating the degree of shift from aromatic to aliphatic molecules, the increase in amount of lower boiling liquids and the increase in percent hydrogen.

The subgroups studying molten salt catalysts investigated three Lewis acid melt systems, $ZnCl_2$, $ZnCl_2 + AlCl_3$, and $ZnCl_2 + SbF_5$. The concept of increasing hydrogenation with increasing catalyst acidity (in the Lewis sense) was confirmed. There is increased hydrogenation in those systems with greater acidity: those containing the stronger Lewis acids, $AlCl_3$ and SbF_5. The subgroup also found an increased trend toward hydrogenation with increasing catalyst-to-reactant ratio. Finally, the subgroup noted that temperatures greater than 450°C resulted in increased production of an insoluble char. This fact, however, had been noted in several previous studies.

The subgroup studying homogeneous transition metal complex catalysts concentrated its attention on the behavior of these catalysts when used alone and in combination with a bulk support catalyst of proven ability. The support catalyst was Harshaw's 0402T, a silica promoted cobalt-molybdenum catalyst on an alumina support. The homogeneous catalysts investigated were $Co_2(CO)_8$, $Mo(CO)_6$, $Cr(CO)_6$, $W(CO)_6$, $SnCl_4 \cdot 5H_2O$, $PdCl_2$, and $CuSO_4$. All results indicated increased hydrogenation yields with Harshaw's 0402T and a promoter as compared to 0402T alone. In the case of the metal hexacarbonyls, best results were attained when the catalysts were used independently; there was a trend toward increased hydrogenation from Cr to Mo to W. $PdCl_2$ and $SnCl_4 \cdot 5H_2O$ produced the best results, as promoters of Harshaw's 0402T and especially in combination with each other.

Reference copy: Science Library, University of Alabama

****

Possible Teratogenic Effects Induced by Pesticides (Grant no. GY-11485)

Central Washington State College
Ellensburg, Washington 98926

June 10, 1974 - August 30, 1974

Participants:

Martin E. Hicks*
Robert J. Miller
Michael A. Mitchell
Nancy W. Sowdon
Gary Stiegler

*Student Project Director

Thomas H. Thelen, Faculty Advisor

In 1971, six 5-legged frogs were collected from a pond in Spokane, Washington. Because of the frequency of occurrence and the variability in number and position of attachment of the extra legs, natural mutation was ruled out. Upon checking with city officials, it was discovered that these frogs had been found about five years before by a local high school science teacher. It was also learned that the pond had been treated with DDT for mosquito control up until 1966. The DDT treatment was the only apparent man-induced change in the pond.

With the possibility of polyleggedness caused by DDT, we initiated a literature search. The literature tended to indicate this was a possibility but no specifics could be found. However, the search did show that rather than a mutagenic effect we were probably dealing with a teratogenic effect.

Our research was, therefore, designed to encompass two areas of study. First, a water analysis study of the pond was made to determine if there were any other abnormalities in the water chemistry. Secondly, we reared Rana pipiens embryos in the laboratory under maximized conditions to determine if DDT or other pesticides could indeed cause this effect.

The water analysis (phosphate, nitrate, sulfate, mercury, lead, chemical oxygen demand, pH, etc.) was accomplished without major difficulty. The water we are analyzing comes from a small, shallow (approximately 2 meters in depth) pond. There is no stream or inlet of constant outside water flow and also no direct drainage. The pond lies in a low basin, and its water is apparently supplied by underground seepage. The water environment contains abundant plant growth, fish, frogs, and numerous turtles. The determined chemical oxygen demand showed the water to be quite high in oxidizable organic matter - 39.53 mg/1. The nitrate and phosphate levels of the water are very low, which is possibly due to their rapid assimilation into living organisms present in the pond - phosphate 0.015 ppm, nitrate 0.1 ppm. The sulfate content of the pond water was quite high - approximately 30 ppm - corresponding to a high pH of approximately 8.26. The amount of mercury (Hg) detected was low - below 0.01 mg/ml, but lead (Pb) concentration was approximately 1.1 ppm. The pond has not been treated with DDT since 1966 but is tested frequently for mosquito larvae, and if their density necessitates, the pond is subsequently treated with mineral oil. The mineral oil may be one of the sources of lead, but there are other possibilities, including automobile exhaust and gasoline, as the pond is in close proximity to a major thoroughfare. One would think that the DDT residue level of the water should be quite low. DDT has a tendency to volatilize and to be absorbed into organic matter, thus disappearing from solution. Because of these factors, a sediment sample should show a larger concentration of DDT residue than the surrounding water. Therefore, the DDT analysis will not be complete until it has been.

To broaden the scope of the biological studies dieldrin, aldrin, endrin, toxaphene, and chlordane were used in addition to DDT. Three concentrations of each pesticide were employed. The highest concentration was the TL_{50} value for the pesticide on amphibians. The other two concentrations were successive ten fold dilutions. Synergisms between DDT and the other five pesticides at all three concentrations were also explored.

The rearing medium was a standard Holtfreter's Solution which has a total salt content of 0.385%. This medium is hypotonic to adult tissues but seems to be isotonic to the embryonic states of the Anura.

Inducing ovulation in Rana pipiens is supposedly very simple. However, we worked for over four months before finally obtaining a successful ovulation. The procedure employed involved injecting two fresh female pituitary glands (or four male pituitary glands), which had been previously macerated in 1.0cc full strength amphibian Ringer's solution, into the body cavity, posteriorly and to the side of the ventral abdominal vein. In addition to the pituitary glands, 5 mg progesterone in 0.2cc of solution was injected intramuscularly into the thigh muscle.

When ovulation had been achieved, a male was selected, and the testes removed and macerated in 5.0cc of 10% amphibian Ringer's. The solution was then allowed to stand for 15 minutes to obtain maximum motility of sperm.

The eggs were manually stripped from the female into a petri dish. The sperm suspension was then pipetted over the eggs, making sure all eggs come into contact with the suspension. After allowing to stand for 15 minutes, the eggs were flooded with distilled water. After standing for an additional 15 minutes, the water was changed with fresh distilled water and let stand for another 15 minutes. The eggs were then cut into strips of ten each and distributed to the containers already prepared with the Holtfreter's solution to which the pesticides had been added.

We wanted to maximize conditions in order to augment the

the teratogenic effects of the pesticides. Even considering the long half lives of the pesticides being used, we decided it would be best if we renewed the pesticide daily by completely changing the water. We felt this was only necessary for the first week, however, when all tissue determinations in the amphibian embryo are not complete.

The first experiment involved approximately 5000 embryos in 176 different containers. The embryos were developing normally for the first five days and there was some evidence of hatching present. Then, for no apparent reason, all embryos (including the control groups) died. We have been unable to determine why this occured. Developmental stage analysis has shown nothing.

Reference copy: Library, Central Washington State College

****

Model Methane Production Process for Wake County, North Carolina (Grant no. GY-11442)

North Carolina State University
Raleigh, North Carolina 27607

May 20, 1974 - August 9, 1974

Participants:

Barry L. Cates
David E. Faucette
Bill T. Firth
L. Harrison Hassel
Jerry B. Holman
Edwin D. Mantiply

Jacob M. Rudisill*

*Student Project Director

Gerald H. Elkan, Faculty Advisor

New sources of energy are being sought today in the hope of avoiding an energy crisis. Methane is one fuel that is becoming more and more attractive in view of the limited amount of natural gas available. The purpose of this study was to investigate the possibility of producing methane and, thus, reducing the shortage of natural gas. Three questions were to be answered: 1) What methods of methane production are available today?; 2) What methods of methane production are applicable?; and 3) How should a model methane production process be designed?

To achieve these objectives, the study was divided into two parts, a systems study and a laboratory study. The systems study examined the available technology to find methane production processes and to determine the design, operation, and economic feasibility of production plants on three levels -- municipal, home, and intermediate. Also included were a public opinion survey to determine public acceptance of the methane production models and the conversion of an automobile to use methane as fuel. The laboratory study was to determine the optimum conditions which would maximize methane gas production. Temperature, concentration, and detention time were the parameters examined.

One well-known process of methane generation is anaerobic decomposition of sewage sludge. Microorganisms inherent to the waste digest the sludge in a three-step microbiological process from which methane is a natural by-product.

In addition to a combustible gas as a by-product, a fertilizer can be made of the end-product. When digested sludge is dried, it is ordorless and can be used as a soil conditioner.

A second process for methane production that was investigated is the algal-methane system. In this scheme, algae grown in sewage effluent is harvested and deposited in an anaerobic digester where it ferments and produces methane.

To determine which process should be used, a study of the competition for the resources involved was made. The cost of the primary method of methane production wastewater treatment can be approximated by the methods of point estimates and cost functions. These estimates approximate capital and operation and maintenance costs. Three fairly accurate cost functions for wastewater treatment were discovered through bibliographical research. From these cost functions, it was evident that trickling filters are cheaper than activated sludge except where low to zero BOD effluent levels are required. As for the other method of methane production, solid waste treatment, cost estimates are more difficult to make. Of the several methods of solid waste treatment, only grinding allows methane production, but this process suffers from operational and financial drawbacks.

To estimate the benefits of methane generation, market conditions for natural gas (92% methane) had to be known. Although reserves of methane are present in the United States, authorities claim that Federal regulation of well-head prices impede the drilling for them. Noted economists concur with this opinion, concluding that well head prices must rise or a 25% shortage of total demand will occur. This suggests that the value of methane will increase, making methane-producing wastewater treatment plants attractive, and methane-producing solid waste treatment plants possible.

The design parameters for a model methane production process are maximum methane and satisfactory waste treatment.

In general, the BOD level of a treatment plants effluent is the major consideration of the latter parameter. The effluent stream and its self-purification ability determine the level of this BOD level. From the Thomas equation, the waste load for the creek can be determined. From data gathered by the Civil Engineering Department of NCSU, the waste load on the Neuse--the most probable effluent stream for the City of Raleigh--was found to be a maximum 5 BOD_5 for 30 mgd.

A municipal sewage treatment plant for the City of Raleigh able to handle the 1985 projected flow of thirty-million gallons per day of waste-water was designed. The influent BOD_5 level of $300^{mg}/l$ would be reduced to $3^{mg}/l$ upon exiting from the plant. Anaerobic digesters, complete with gas recirculation mixing and temperature control, were used to digest the sludge which produced 500,000 cu. ft. of methane per day. An estimate of the cost, using Environment Protection Agency data containing cost functions for individual components, was 16.3 million dollars. This can be compared with the cost of the presently-under-construction Neuse River plan of 29.6 million dollars. Addition of garbage to sewage sludge was not found to be feasible because of the high cost of grinding and sorting and the tremendous digester volume required to treat the garbage.

An intermediate plant that served a division of 400 people and treated only settleable solids to produce methane was designed. The plant would produce 500 cubic feet of methane per day, as well as supplying a soil conditioner to homeowners in the area. A rough cost estimate of $25,000 to $50,000 was made.

For the home unit, the Cycle-Let^{TM} System, marketed by the Thetford Corporation, was used (with some modifications) because of its simplicity and efficiency. Water from the unit was recycled and enough methane was produced to heat a family's water. The initial capital cost of the system was $3,000, but a reduction on electric and water bills of 30% and 40% would result.

The public opinion poll showed that there was a general lack of knowledge and information on the subject of methane production by sewage treatment. However, it was found that a large number of people were interested in having a home methane generation unit and that three-quarters of those polled would buy dried sludge as fertilizer.

An automobile was converted to use methane as a fuel by simply adding commercial gas conversion equipment. The car ran roughly while on methane. More time was need to make adjustments so that it would run better. It was concluded that methane was not feasible for large engines and long trips.

In the laboratory study, two procedures were used. One employed a Warburg apparatus to ferment sewage sludge of various concentrations at three different temperatures. The second procedure involved the fermenting of 500 ml volumes of sludge of four concentrations at a temperature of 35°C. Both procedures included methods for measuring gas production rates and taking gas samples for gas chromatography.

The experiments utilizing the Warburg apparatus did not produce any useful results. This eliminated the temperature study. The 500ml batch digesters were allowed to run for 27 days during which time the gas production rate data were obtained.

An optimum concentration of 6% was determined.

The results of the laboratory study indicate that detention time increased with concentration. While a concentration of 3% gave the shortest detention time, the best concentration in terms of gas production was found to be 6%.

Various conclusions were garnered from this project. For example, the laboratory results showed that methane production of sewage sludge was greatest at 6% solids. This value was, thus, used in the design of a model methane production process.

The systems study concluded that a model methane production process is technically possible on three levels of development: municipal or centralized, intermediate, and home or decentralized.

Given the present economic conditions, the municipal plant appears to be the only feasible design. The intermediate and home designs will become feasible only when natural gas prices are allowed to rise, city government incentives for decentralized treatment are instituted, and the value of the externalities of home methane production increases.

The public opinion poll showed that Wake County residents maintain an interest in methane production and that at least 50% of the residents are willing to invest money in some kind of home digester.

A major conclusion of this project was that a further study of novel methane production methods is needed. The aerobic-anaerobic, anaerobic filter, and algal methane processes have promise for methane production and water waste treatment. Pilot plant studies are needed to determine their feasibility.

. ference copy: D.H. Hill Library, North Carolina State University
****

The Identification of Man-Made Reservoirs for Human Pathogens in the Human Environment (Grant no. GY-11536)

University of Georgia
Athens, Georgia 30602

June, 1974 - September, 1974

Participants:

Mayfield Camp, Jr.	Craig N. Fievet
Karen C. Cone	Cheryl J. Hill
Jan E. Duffy	Howard S. McCullough, Jr.*
Jack Dwosh	Rex L. Schuder

Nathan L. Stephens

*Student Project Director

Gene E. Michaels, Faculty Advisor

The goal of this project was to examine areas of our environment where human contact is very high, and where the potential exists for these areas to be contaminated with pathogenic organisms. Hazardous conditions may exist in enclosed shopping center malls, and other areas where many people come in contact with small areas of soil

In order to identify the areas as potential environmental hazards, certain conditions are necessary. There must be high concentrations of people in a small area, places where pathogenic organisms can collect, and the possibility of direct human contact with the pathogens.

An enclosed shopping center was monitored for pathogenic organisms. Many people visit the mall and continually make contact with the ornamental planters inside the mall. Soil and swab samples were taken from the planters. The specimens were plated on to selective and differential media for cultivation of pathogenic bacteria, fungi, and actinomyces. Many aerobic organisms, potentially pathogenic for man, were found:

Staphylococcus aureus (coagulase positive)
Streptococcus sp. (alpha-hemolytic)
Escherichia sp.
Pseudomonas sp.
Klebsiella sp.
Citrobacter sp.
Pectobacterium sp.
Diplococcus pneumonia
Absidia sp.
Aspergillus sp.
Cephalosporium sp.
Cladosporium sp.
Curvularia sp.
Fusarium sp.
Geotrichum sp.
Microsporium sp.
Mucor sp.
Paecilomyces sp.
Penicullium sp.
Rhizophus sp.
Scopulariopsis sp.
Trichophyton sp.

After it had been determined that potential pathogens existed in the mall planters, environmental variants in the mall were studied for their participation in bacterial growth. The three planters showing the highest numbers of organisms were compared with the three planters showing the lowest numbers, to demonstrate the differences in the environmental conditions around them:

	HIGHEST	LOWEST
pH	6.8	7.2
LIGHT (foot candles)	1000	400
TEMPERATURE	72°F	72°F
POPULATION DENSITY	GREATEST	LEAST
PLANTS	BACK FROM THE EDGE*	UP TO THE EDGE**

*The plants were far enough back from the planter edge to expose the soil.

**The plants were close enough to the planter edge to cover the soil.

Several experimental planters were developed to measure the effect of varying one condition at a time. Each of the previous determined conditions had the same effect on bacterial numbers as did the ones measured in the mall. In the experimental planters, two other parameters were studied. The watering schedule of the mall planters (every other day) proved to be the most conducive for high bacterial numbers. In the experimental watering variations, the plants grew best when given only two cups of water per week. This also substantially decreased the bacterial numbers. Chemicals added to the experimental planters inhibited bacterial growth. Formaldehyde, in concentrations that substantially decreased bacterial growth, was also detrimental to plant growth. Crystal violet (an aniline dye), when added in nearly any concentration (0.5 - 10.0 ppm) inhibited bacterial growth but did not harm the plants.

Several new designs were drawn up in order to decrease human contact with the planters and planter material. Decreasing the amount of water and having the plants grow up to the edge of the planter were considered to be very important features in reducing the potential environmental hazards. Making available more trash cans and ash trays in more obvious places tended to encourage their use instead of the planters. The introduction of pathogenic organisms appears to come from the trash that people put into the planters. Excluding the trash will improve the appearance of the planters and will eliminate the pathogens that can remain viable for a long time.

Reference copy: Science Library, University of Georgia

****

Hematological Changes Due to Chemically-Induced Hepatic Tumors in Sprague-Dawley Rats (Grant no. GY-11503)

Maryville College
Maryville, Tennessee 37801

June 17, 1974 - August 23, 1974

Participants:

Elizabeth Buchanan	Thomas C. Martin
Arthur T. Fowler*	Craig D. Rigell
Barbara A. Kerr	Kathy A. Taylor

Paul D. Viggiano

*Student Project Director

W. Gale Rhodes, Faculty Advisor

Fifty-two male Sprague-Dawley rats, approximately eight weeks old were divided as equally as possible by weight and number into three groups. The first group (A) was fed a known hepato-carcinogen, 6-(p-dimethylaminophenylazo)quinoline, which was synthesized via the reduction of 6-nitroquinoline to the corresponding amine and its subsequent diazotization and coupling with N, N dimethyl aniline, at a 0.01% level; the second group (B) was fed the same compound at a 0.03% level; and the third group (C) was fed the same special diet as was fed the other two groups, but with no carcinogen added. This special diet, patterned after the low-protein, low-riboflavin diet of Miller and Miller (Advances in Cancer Research, 1:339ff, 1953), contained (on a kg basis) 750 g dextrose, 120 g casein, 40 g rice powder, 40 g Osborne and Mendel salt mixture, 50 g corn oil, 0.5 mg riboflavin, 70,000 I.U. vitamin A, and 150 mg iron. All food and water was administered *ad libitum*.

Blood was withdrawn weekly from each rat for determination of trace concentration of sodium, potassium, calcium, magnesium, and zinc, using Atomic Absorption/Emission spectrometry. This blood was monitored in the form of plasma which resulted from the centrifugation of about 1.5 cc whole blood obtained by means of intracardial sticks. Further, 44.7 lambda of blood was obtained by means of femoral vein sticks for a complete blood count (CBC). These tests included the determination of the number of red blood cells, number of white blood cells, hematocrit, mean corpuscular volume, hemoglobin, mean corpuscular hemoglobin concentration, and mean corpuscular hemoglobin (MCH). These seven tests were carried out on a Coulter Counter after the whole blood was properly dispersed in a Isoton solution. Finally, in addition to the described blood tests, all rats were weighed at three-day intervals.

The previously described 12 blood tests were carried out for an eight-week period, yielding eight ion determinations for the five ions and 17 CBC's. During this period six rats were lost because of pericardial bleeding from intracardial sticks, and all rats showed some physiological indication of the effects of the restrictive diet and excessive blood letting. The primary indicator of this physical effect was the large weight loss incurred by the groups, with groups A, B, and C possessing only 74%, 66%, and 78% respectively of their initial body weight at the end of the eight-week period.

While both groups A and B received continuous feedings of hepato-carcinogen, only rats fed the higher dose (B) acquired significant liver abnormalities. Of the 13 rats in group B that survived the experiment, two had normal livers, five showed indications of marked cholangiocarcinoma (bile duct carcinoma), one acquired a hepatoma, and all others had some form of atypical cellular activity, whether it was in the form of hepatic cell necrosis, hepatic cell regenerative activity, or bile duct hyperplasia.

The first and major change that can be noted,both for the six tumor rats as well as (to some extent) the entire B group, is that they consistently had higher and more variable white blood counts, indicating either the body's reaction to the necrotic state of the liver or the rats greater susceptibility to infection from other sources. From the second week to termination, for example, the B group had an average WBC of about 3,000 higher than the control.

A second change that was observed in all groups was a marked decrease in mean cell volume. All groups lost an average of about 6 μ^3 in volume, a typical deviation being from 55-49μ^3, as was shown in the C group. Since these changes occurred in all groups, this would indicate that this phenomenon (i.e., the decrease in cell size) is not tumor related, but rather is a result of the large amount of blood letting. While the mean corpuscular hemoglobin also showed a similar decline, all other tests of the complete blood count showed little variation during the eight-week period.

With respect to trace metal ion determination, it can be stated that the concentration of potassium showed a slight decrease in all three groups. The alteration appears to be only slight and not tumor related. The concentration of zinc also decreased in all three groups, the average decrease being about 1 ppm. The zinc concentration did show a larger decline in the B group than in either of the other two. The fact that all groups showed a decrease in zinc can probably be attributed to a dietary deficiency since the salt mixture of the diet (the salt mixture being practically the only dietary source of metal ions) contained no zinc; however, because the B group showed a greater decline, the phenomenon may be of tumor-related causes. The concentration of sodium, calcium, and magnesium showed little variation during the eight-week period.

Several general conclusions can be drawn from the results described: 1) that the presence of tumor seems to have some hematological effect on the rats, particularly in zinc concentration and number of white blood cells; 2) the large volumes of blood that were withdrawn from the rats caused hematological changes which may have masked changes caused by tumorogenesis; 3) as a result of #2, future work in this area should center around only a few tests (e.g., Zn, WBC), less blood should be withdrawn, more iron should be added to the diet, and experimentation should be carried out over a longer period of time. Reference copy: Lamar Memorial Library, Maryville College.

****

Biostatistical Methods Applied to Clinical Chemistry and Sports Medicine (Grant no. GY-11489)

CUNY - Hunter College
New York, New York 10021

June 3, 1974 - August 23, 1974

Participants:

Vito Calamia — Christine Hrabik
Elizabeth Rusin Donahue — Paul Nani
Karen Rauhauser*

*Student Project Director

Non-Stipend Participants:

Janice Dworkin — Donald Marks

Jack Hachigian, Faculty Advisor

Research in preventative medicine has intensified in the recent past in the hope of providing improved health care. In particular, the areas of sports medicine and clinical biochemistry are concerned with developing refined techniques for the prediction and prevention of injuries and disease, respectively. With the intensification of this research and the enormity of collected data, it becomes more and more apparent that both the mathematician and statistician must be incorporated into this trend.

The doctors in the sports medicine study had been studying the concept of ligamentous laxity which is defined as looseness in joint and ligament areas of the body displayed anatomically by such things, for example, as the extent to which the thumb can be pressed against the forearm; the extent to which the index finger can be pressed towards the back of the hand; the extent to which the knee cap can be displaced. Their interest was in the investigation of the correlation of ligament laxity with injury proneness and whether the subsequent relationship is dependent on specific sports as well. Based on years of clinical experience in the Sports Medicine Department of the Hospital for Special Surgery (HSS) and in depth data collection, it was hypothesized that ligament laxity could be quantified and then could be used to indicate injury proneness in sports. Namely, it was hoped that the results of such a study would enable a physician, parent, or coach to decide whether a prospective athlete should be discouraged from participation in certain sports because of the degree of ligament laxity present. It was further hoped that the types of injury one would be most susceptible to could be predicted.

Data were collected using the Athletic Profile which consists of four (4) sections: general information, athletic participation, injury history, and ligament laxity examination. The data on approximately 800 subjects came from various athletic sources, including professional, college, and high school team members in various sports; seasonal and weekend players; and occasional or rare participants in sports. The injury data used in the analysis were a condensed version of the "injury history" on the Athletic Profile. We sorted out those injuries where ligament laxity might have been a contributing factor and deleted those injuries which were due to direct impact. In addition, each sport was analyzed individually, since it was hypothesized that the effect of ligament laxity would vary from sport to sport. Consequently, there was a further breakdown of the injury data into groups according to the sport in which the injury was obtained.

Our analysis of the relationship between ligament laxity and injury proneness began with the idea that across-the-board laxity (namely high scores on each of the tests) would be indicative of a high percentage of injuries in certain sports. The quantification of ligament laxity was therefore, in its first stages, a linear sum of the test results: $T_1 + T_2 \ldots\ldots + T_7 = L21$, where L21 was our designation for the "ligamentous laxity index". In our analysis of the L21 as a predictor it became apparent that the percentage of injuries in sports was highly dependent on level of participation. Namely, the L21 was not an accurate predictor across all levels of participation, since the "lax" high school football player was much more likely to be injured than someone who has the same degree of laxity and plays football occasionally. It appeared to us that there were combinations of measurements which were meaningful but how these measurements combined eluded us. Therefore, we searched for techniques which would extract the information contained in these combinations, but would not necessarily result in a single numerical representation of an athlete, such as L21. With this goal in mind, we used the statistical technique of discriminant analysis. Discriminant analysis allowed us to quantify athletes into zero (0), one (1), two (2) injury categories with a very high degree of accuracy.

The clinical chemistry study has its origins in the data collected in the Biochemical Laboratory at HSS where blood samples are analyzed by SMA 12/60 Technicon. The analysis yields the levels of 12 chemicals found in the blood and this analysis makes up the automated part of a complete blood test. The acceptable level of each of these chemicals was assumed to follow a specified statistical distribution based on a sample taken by the company which manufactures the SMA 12/60. It was suspected, by the physician in charge, that the patients at HSS constituted, in blood biochemical terms, a subpopulation which was different from the population used to standardize the normal ranges for the blood analyzer. Therefore, our first goal was to sort out those patients whose 12 test results fall simultaneously in the acceptable regions on any one blood sample and analyze the statistical distribution of each of the 12 chemicals over this hospital's population. Secondly, we tested the hypothesis that the 12 distributions obtained were different from those assumed by SMA 12/60 to represent the overall population and further analyzed the factors contributing to this difference.

The motivation for the clinical biochemical laboratory study stemmed from a desire to increase the efficiency of diagnostic practices within the hospital. For instance, if, on certain blood test results, a patient appears to be in the unacceptable range, this may prompt the physician to order further tests to isolate the cause of such abnormalities. But the same blood test results may be considered average within the subpopulation at HSS if, in fact, an analysis proved that there is a different patient profile at the hospital. Therefore, the physician might not have been concerned over the test results of his patient and possibly could have reduced the number of further tests to be administered. In general, the statistical analysis of such a set of blood chemical levels, combined with medical judgement, might possibly enable the physician to refine his diagnosis, given the fact that he is examining a member of a specific subpopulation.

Reference copy: Hunter College Library

****

Water Factors Affecting Cardiovascular Disease Rates in Three Neighboring Upstate New York Communities (Grant no. GY-11542)

SUNY - State University at Binghamton
Binghamton, New York 13901

June 3, 1974 - August 9, 1974

Participants:

Fern Blumenfeld	Gregory Hollod
Robert Goltz	Steven M. Kempner*
Gary Hammond	Maria Romanowski
Walter Hill	Robert Soutner

Sherry Waldman

*Student Project Director

Bruce McDuffie, Faculty Advisor

Since the late 1950's many reports have described a relationship between drinking water content and cardiovascular disease. An inverse correlation is often found--the harder the water, the lower the death rate. However, it is not known what exactly this "water factor" is. Some workers in the field suggest that soft water, which is usually more acidic, has a greater content of certain trace metals, especially cadmium, which may be related to hypertension.

We have studied this relationship in the triple cities area of Binghamton, Endicott and Johnson City. The three communities have separate water supplies. Binghamton (population in 1970, 64,123) uses Susquehanna River water. Endicott(1970 population, 16,556) and Johnson City (1970 population, 18,025) use well water.

Our study of this problem involved the following: 1) an examination of population death rates from cardiovascular diseases for the three communities from 1959-71; 2) a detailed analysis of the drinking waters of the three communities; 3) a study,with rats, using different drinking waters to try to determine more exactly what factor or factors of the drinking water are involved; 4) a survey of the three communities to determine how other factors known to be related to heart disease (diet, smoking, exercise) differ in the communities and to determine average amounts of water drunk in each area by the residents.

Death rates for each year from 1959 to 1971 categorized by cause, age, sex and race were calculated, using numbers of deaths obtained from the New York State Department of Health and population figures from the U.S. Census.

Three-year average death rates with standard deviations were calculated for 1959-61 and 1969-71 for each community for the category "diseases of the heart". These years were used because interpolated populations around the census year are more reliable. The t-test was used to compare the death rates. Thirteen-year average death rates and standard deviations were also calculated and compared by age groups and sex. The age groups used for our study were 45-54, 55-64, 65-74, 75-84, 85 and over, and all age totals.

We found few significant differences in death rates between the communities ($p < .05$). Binghamton was not found to have the highest death rate as would be expected from its soft water. These results do not justify a conclusion that death rates from "diseases of the heart" differ between the three communities.

Death rates from cerebrovascular disease were calculated for the years 1959-61 and 1969-71, and also for the 13-year period 1959-71. Although these death rates are based on fewer numbers than those of "diseases of the heart" and are less reliable, they also show few significant differences between the communities.

Five times during the summer, water samples were taken at approximately 10 sites in each community. Employees of S.U.N.Y. at Binghamton (the same people all the time) were given clean two-liter plastic bottles and asked to fill them the following morning with cold water drawn from their kitchen tap after allowing the water to run approximately thirty seconds. On being returned, the water was analyzed for pH, conductance (corrected to specific conductance at 25°C), total hardness (as calcium carbonate, by EDTA titration),sodium, magnesium and various trace metals.

A Perkin-Elmer Model 303 Atomic Absorption Spectrophotometer (AA) was used to analyze for sodium, magnesium, zinc, copper, nickel, lead, cadmium and chromium. The method of standard addition was used to calculate concentrations.

Rat tissues, which were digested by a single-step wet ash procedure, were also analyzed by AA for calcium, magnesium, copper, nickel, and zinc.

Average hardness for Binghamton, Endicott and Johnson City were found to be 71 ppm, 169 ppm, and 300 ppm, respectively. Percent standard deviations were approximately 15 to 20% of these values. Sodium and magnesium levels as expected, varied directly with those values and were, respectively, 10 ppm, and 4 ppm for Binghamton; 11 ppm, and 18 ppm for Endicott; and 17 ppm, and 28 ppm for Johnson City. Percent standard deviations for those values were much higher, close to 50%. pH was lowest for Binghamton (7.16) and highest for Johnson City (7.30). Endicott was very close to this value (7.29).

Copper and zinc, although very variable, were highest in Binghamton, and lowest in Johnson City. Lead, cadmium, nickel and chromium were all below limits of detection, and for this reason differential anodic stripping analysis was used in the fall to test for cadmium and lead: the concentrations respectively (ppb) were found to be 2.2 and 7.0 for Binghamton; 2.1 and 11.0 for Endicott; and 1.6 and 3.8 for Johnson City.

Sixty male Sprague-Dawley rats were divided into six groups and given drinking water as follows: Group 1, 200 ppm calcium; Group 2, 25 ppm calcium; Group 3, 25 ppm calcium and 5 ppm cadmium; Group 4, 200 ppm sodium; Group 5, 25 ppm calcium plus 400 ppb copper, nickel and zinc; Group 6 distilled water. The first three groups were on their water diets for over 120 days at the close of the experiment, while the last three groups were on their water diets for approximately 60 days.

Blood pressure readings were made with a tail cuff and microphonic manometer five times weekly during the last half of the study period. Animals were warmed to 40°C in an oven and then held while the cuff and microphone were applied and blood pressure readings taken. At the close of the study period blood and organ samples were taken following decapitation. Blood serum analyses were performed at Wilson Memorial Hospital, Johnson City. Heart, liver, kidney and bone samples were digested using a concentrated nitric acid --70% perchloric acid mixture and the resulting filtrate was analyzed by AA. Since the animals were of different ages, statistical analyses were performed to compare the groups.

No significant differences were found among any groups in blood pressure. Since many other workers have reported differences, it is possible that the length of the study may be involved. The most notable differences found in the blood sera were: Sodium significantly higer in Group 3 than 1 and 2 ($p < .05$) and in Group 4 than 5 and 6 ($p < 0.01$); calcium significantly lower in Group 3 than 1 and 2 ($p < .05$) and significantly higher in Group 4 than 5 and 6 ($p < 0.01$); Glucose, cholesterol and triglycerides showed no significant differences. Trace metal analysis of the rat organs gave widely varying results. Cadmium content of Group 3 organs were greatly elevated especially in the liver and kidneys where it is known to accumulate.

A questionnaire survey of people aged 35-74, with 191 participants from Binghamton, 96 from Johnson City and 104 from Endicott was completed during the project. Questions included those on diet, exercise, length of time in present and previous homes, and present and previous jobs, amounts of tap water consumed at work and home, years and amount of smoking, and incidence of heart disease and type in the respondent's family. The results were stored on computer tape and a standard package of computer programs was used to analyze the data.

The highest incidence of some form of heart disease was in Johnson City (35.8% as compared to 33.5% for Binghamton and 26.9% in Endicott). These figures do not agree well with our death rate data for 1959-71 which show few significant differences in age-specific death rates among males and females in the three communities.

In all three communities, the participants have lived in the present home for an average of over 20 years. Endicott had the largest percent of employed residents who work in the same community, but all three communities are over 50% in this respect. The communities are very nearly even in water drunk at home and work, and in daily exercise when including both home and work. One major difference between the communities is that Binghamton has the largest percentage of smokers and smallest percentage of those who have stopped smoking.

Our study has not shown any differences in the death rates of the three communities. One possible reason for this is that, although hardness differs in the three communities, the trace metals some workers feel are mainly involved in the "water factor" do not show this same variation. The "mixing" factor which we feared might obscure the differences may also be involved, but our survey results do not indicate that this is as large as we initially thought. Other factors known to be related to heart diseases are very similar in the three communities and do not seem to be a major consideration. Our experiments with rats have suggested that drinking water constituents may alter blood serum and tissue concentrations, and these changes may be directly involved in the relationship.

Reference copy: Science Library, SUNY - State University at Binghamton

****

The Utilization of Waste Heat for Domestic Purposes (Grant no. GY-11546)

Wesleyan University
Middletown, Connecticut 06457

June 10, 1974 - August 16, 1974

Participants:

Jane Canning	Marilyn Marx
Eric Erslev	Christopher Maturo
Ernest Fontaine*	Susan Peckham
Barron Lambert	Judy Piranian

Edward Wu

*Student Project Director

Jelle DeBoer, Faculty Advisor

The Maromas Fossil Fuel Plant in Middletown, Connecticut operates at an efficiency of approximately 40%, which means that, of the energy used to create electricity, 60% is being wasted in the form of heated stack gas and heated condenser cooling water. The aim, therefore, of this project was to utilize the latter waste as a source of energy in the heating of local institutions.

The plant's units 1, 2, and 3 together discharge 200,000 gallons per minute of water used for cooling in the condenser. The water temperature is raised 16° to 20°F in this process. Unit 3, which is the most efficient of these, has a rate of 65,000 to 100,000 gpm, so it was chosen as the supplier for the consumers involved in this study. A list of possible users was narrowed down to Pratt and Whitney Aircraft Corporation and Middlesex Memorial Hospital, with added study on other heating alternatives.

The investigation was divided into three categories: engineering, geology-ecology and economics, in order to cover the major areas of interest in such a project. The engineering team centered its work around determining the energy needs of the consumers, devising changeover systems at the two sites, and planning a pipeline, including pumps. It was found that the hospital's large north and south wings already use a hot water heating system, so direct conversion is possible. Therefore, more time was spent on Pratt and Whitney, where the work focused on the conversion of the four main buildings. When hot water heating already existed, direct conversion was again possible, and where steam coils were present, the team devised a replacement system in which each row of coils would be replaced by two rows of hot water coils. This would produce the same heat output and would also increase the air pressure drop across these coils. Not all of the steam coils were replaced, however, as Pratt and Whitney needs steam for process work.

The pipe (Ric-wil FRP Condensate pipe-fiberglass-reinforced plastic) was selected, as were the pumps (Aurora Series 411) of which two will be installed at the plant, one for directing the water to each consumer.

The last step was directing the water from the plant to the consumers, an area which was not completed because of time and capabilities limitations. The major work done was the tapping of steam from existing steam valves of Unit 3, which would raise the temperature to 190°F.

The geology subgroup of the geology-ecology team conducted studies on the climate and topography of the state in general and the Middletown area specifically. Fieldwork included observations at the plant site and a survey of the selected pipeline route, using an auger and a shovel to gather information on surficial materials and depth to bedrock. It was found that shallow bedrock in some areas would require extensive blasting, while other locations would involve the building of the pipeline across trestles.

In addition, a study of the calefaction (the disposal of warmed water into a natural body of water) of the Connecticut River by the power plant effluent was conducted. This included an analysis of the river's normal temperature and volume, compared to the temperature change caused by the consumer. Of major interest was the effect of the effluent on the river's fish, phytoplankton and zooplankton. It was found that the warmed water does not adversely affect these organisms, and in some cases causes a population growth. Indeed, the area around the weir has become a popular sport fishery. The only major damage to these organisms arises from passage through the condenser; this is unavoidable in such an open cooling system.

Finally, the group investigated other alternatives for using this heated water, other than the two chosen institutions. These included greenhouse heating, agriculture, aquaculture and the heating of municipal water. In the first two areas, it was found that the geographic location of the plant would not support these uses within any reasonable piping distance, though a model greenhouse was devised. The latter two possibilities seem more promising, although much more study is required. Aquaculture could profit best by raising carp or catfish, of which the latter could be used as the base for a protein meal.

The economics team performed a cost-benefit analysis to determine if implementation of the proposed plans is economically feasible. The work included the tabulating of costs for materials, construction, operation and conversion at sites. The pipe and pump equipment, including tees, runs to $1,849,280, based on current prices, while construction costs, as estimated by a contractor (C.N. Flagg Company, Meriden, Connecticut) come to $446,720, bringing the total to $2,296,000.

It is difficult to determine if Pratt and Whitney would benefit financially from this scheme, for this plan does not simply replace heating units, but adds to the company's production capabilities. The hospital should save 60 to 65% of its current oil costs. This would appear as a positive factor, although some major costs have not been taken into account, notably the conversion at the plant and the possible lowering of the plant's efficiency by the further heating of the water.
Reference copy: Science Library, Wesleyan University

****

Solar Thermal Energy Applications for Home Heating (Grant no. GY-11532)

Sangamon State University
Springfield, Illinois 67208

May 27, 1974 - August 16, 1974

Participants:

David Ayers	John Drabinski*
John Damron	Thomas Empson
Gary Devore	Scott Mapes
Emily Drabinski	Donald Rush

James Stark

*Student Project Director

Non-Stipend Participants

Edward Boyd
Charles Supsic

Alexander J. Casella, Faculty Advisor

The purpose of this study was to examine the feasibility of solar thermal energy utilization for home heating in central Illinois. A corresponding goal was to share the results of this study, as well as other information gathered on various solar energy applications, with the community through workshops.

It was determined that designing, building, and operating a solar-heated system to serve as a laboratory for our study as well as becoming a community demonstration would best suit our needs. A geodesic dome, which had been constructed by a University class, was utilized as the experimentally-heated structure.

During the first week of the project, several student participants and the faculty advisor went to the University of Florida's Solar Energy Conversion Laboratory. The purpose of the visit was to gain first-hand knowledge of an already existing solar-heated system as well as speak to the director and his colleagues about their assessments of the feasibility and problems in designing a solar heated system in the Midwest.

During the next few weeks, current information on solar thermal energy was studied. This included correspondence and literature from both universities and industries conducting research. Climatological data were obtained from the U.S. Weather Service in Springfield, Illinois. Data on solar radiation, i.e., measurement in langleys, were not available. This posed several problems in conducting research in this area. As part of the study, this information has since been monitored and recorded.

A moderate-sized prototype flat-plate solar collector was constructed. Temperatures and radiation data were monitored for the collector, which had a .45m x 1.21m (1.5' x 4') collection surface, which provided for the ability to heat water for a 60.48 liter (16 gallon) storage tank.

Using the results of the model, the large-scale solar heating system was designed. The system consists of twelve 63.9^{2}m (211^{m}ft.) flat-plate collectors, a 7,560 liter (2,000 gallon) storage tank, and sufficient plumbing. Most of the materials were purchased locally within central Illinois.

The flat-plate collectors consist of sheets of extruded aluminum, which were coated with a non-selective flat black paint, housed in an insulated aluminum box under two panes of glass. The second pane of glass was to cut down on heat losses. The collectors were mounted on angle-iron cradles at a 50°angle. The angle was determined by adding 10° to the 40° latitude of the area to achieve the maximum heat gain during the coldest time of the year.

The plumbing system consists of chlorinated polyvinyl chloride plastic 3.2 cm (1¼") manifold with 1.3 cm (½") pipe leading from the collectors to the manifold. The pump for the collectors is controlled by a device that measures the temperature differential between the tank water temperature and the collector water temperature so that when the collector temperature is lower than the tank temperature the water does not circulate.

The storage tank was completely insulated. It was first coated with coal tar sealant (inside and outside) to prevent rust and increase insulation. Two additional holes were cut into the end of the tank for an additional inlet and outlet. Two layers of 7.6cm (3") thick fiberglass insulation were attached to the tank before it was wrapped with tar paper and coated with tar. It was finally given a coat of white paint as a reflective coating to prevent melting of the tar.

Within the strucutre are baseboard radiators. The radiators are conventional convection-type hot water units. The flow of hot water from the storage tank to the structure is thermostatically controlled.

Copper constanton (type T) thermocouples have been attached at various points throughout the system to measure the water temperatures. Air temperatures are being monitored similarly in the collectors, as well as inside and outside the structure. A net radiometer at the collector bank is being used to measure the amount of solar radiation initially entering the system.

Delays in the arrival of monitoring equipment have made it impossible to state a precise heating load assumed by the solar heating system. However, observations indicate that the tank water temperature has risen to a maximum of 70°C (159°F) and the water temperature in the collectors have reached a maximum of 100°C (212°F). The latter temperature has been a problem because of the production of steam in the collectors.

The system was designed to have a water/anti-freeze mixture flow through the system. However, this year's anti-freeze shortage has made using a high concentration of anti-freeze impossible. Ultimately a heat exchanger will have to be installed. Anticipating long freezes and the occasional failures of the system, auxiliary sources of heating are being considered.

Reference copy: Sangamon State University Library.

* * *

The Diffusion and Dissemination of Computer Technology in the Denver Metropolitan Area (Grant no. GY-11533)

University of Denver
Denver, Colorado 80210

June 1, 1974 - August 31, 1974

Participants:

Timothy W. Collins
Mary Therese Hasouna
James D. Hoff
Thomas Philip Hufford
Roger P. Morie
Katherine T. Nakata*
Elinor Joan Nelson
Georgia Shelton
Baldave Singh

*Student Project Director

Joseph Szyliowicz, Faculty Advisor

In the contemporary world, which is characterized by an increasing disparity between developing and developed countries, the diffusion of technological innovation constitutes one means of ameliorating this situation. Further research is needed into the diffusion processes of material artifacts and various techniques, especially for use in the management of efficient transfer of innovation to developing countries. Moreover, throughout the world, during the last decade, computer technology has come to play an increasingly vital role in the operations of virtually every type of organization, and all indicators suggest this trend will continue. As computer technology plays a role in shaping values and directing approaches to the acquisition and utilization of knowledge, it is important to consider which socioeconomic factors effect the adoption and utilization of computer technology.

As originally conceived, this study was concerned with the examination of the technological innovation and diffusion of computers in the Denver metropolitan area. The central focus of the project was to investigate the patterns and rate of computer technology diffusion.

Since the focus of the research question narrowed to an emphasis on computer technology defined as "medical computer application" used in Denver area hospitals, students conducted interviews in fifteen metropolitan hospitals, with the following results:

> No apparent relationship exists between hospital size, date of first adoption of computer applications, or the number of computer applications adopted. These findings appear to be contrary to diffusion theory which, on the basis of the economic model of the capacity of the firm to innovate, emphasizes the availability of financial resources which size affords a large firm to be more receptive and adoptive of innovations, and at a faster rate, than smaller organizations.

There is an inner city crescent configuration of hospitals located in close geographical proximity in which five hospitals have the highest number of computer applications in any other hospitals in the project sample; three of the hospitals (two were large) do not. Also, these hospitals were the first to adopt several computer applications, including payroll, accounts receivable, accounts payable, laboratory records, admissions, discharge, surgery reports, laboratory analyses, radiological applications (nuclear medicine, X-ray), cardiology, epidemiology, and clinical surgical applications. Hospitals not located in this inner city crescent did adopt some of the computerized procedures earlier than hospitals in the crescent; however, with the exception of the aforementioned three crescent hospitals, no hospital outside of the crescent has more applications per hospital than those within. Reasons for this phenomenon cannot be evaluated with the data available to the project.

Provision of computerized services by organizations, other than hospitals, appears to demonstrate a "pull" dynamic of diffusion, reflecting the establishment of rental computerized services to hospitals made available only after several hospitals had independently developed these services.

Accounting procedures were the earliest computer applications to be adopted. Specifically, payroll processing was the earliest and most steadily adopted computer accounting application, occurring in the project sample of 15 hospitals in 1960. All hospitals in the sample now have computerized payrolls. In the sample, accounts payable computer applications commenced in 1961, with accounts receivable beginning in 1962. Accounts receivable application is the second most widely diffused computer application in hospitals in the sample after payroll. First use of computerized central supply inventory occurred in 1967, computerized bed census in 1968, and credit check in 1969.

The rate of adoption of computer applications was relatively slow in the early 1960s (i.e., before 1965) but applications increased rapidly after 1965. In computer applications adopted prior to 1965, the mean average lag time between first and second use was six years, while applications adopted after 1965 reflect a mean average lag time of 1.5 years (which mean average holds for applications adopted after 1970).

With the exception of computerized payroll, "take off" for computerized accounting applications occurred in 1967, with notable increase in the rate of adoption of these applications since. The rate of adoption of medical records and clinical applications began in 1960. There is a definite increase in the number of hospitals which adopt new applications per year; however, certain applications have seemingly leveled off, with the last adoption by hospitals occurring three years ago. One application, computerized clinical laboratory procedures, has actually declined in use.

With the general pattern and rate of diffusion of medical computer application isolated, individual elements and relationships within these relationships may be used as a basis for further research questions from which testable hypotheses may be generated.

Reference copy: Penrose Library, University of Denver

Energy: Waco, Texas 1974. Inventory, Household, Energy Patterns, and Citizen Opinions (Grant no. GY-11436)

Baylor University
Waco, Texas 76703

May 20, 1974 - August 17, 1974

Participants:

Kathy Alexander
Doug Bedell
Mike Clynch
Sue Flicking
Cathy Hayward
Chris Hayward
Randy Hulse
Randy Parker
Jerry Powell
Mike Richards
Beeg Shepard
Charles Tindell
Linda Torres
Jan Trice
Mark Wattier
Charlie Webb

Joe Yelderman*

*Student Project Director

W. M. Alexander, Faculty Advisor

The recent energy shortage in the United States caused many cities to look for ways to conserve energy. This prompted a team of students representing twelve disciplines to analyze energy consumption in Waco, Texas, and to relate it to urban growth and change. The objective was to enable the City of Waco to conserve the most energy with the least cost and to allow for future energy needs.

The first part of the project included a summary of the national position, an aggregate study of the Waco situation, and a study of alternate sources of energy in the immediate area.

1. Electricity consumption in Waco is doubling approximately every eight years, which is in line with national figures. The limitations of the present fuel source, natural gas, have prompted the power companies to anticipate their future needs with a nuclear power plant in nearby Glen Rose, Texas, and with lignite coal reserves from East Texas.

2. The natural gas company can supply most of its present customers' needs for the next ten to 15 years with existing supplies. But natural gas consumption is increasing very slowly as new customers are being limited. This is an improvement over the national situation because of the large natural gas supply in Texas.

3. Gasoline consumption in Waco will generally increase with the number of vehicles registered and will increase in line with the national situation.

4. Alternate sources of energy studied in the Waco area included: solar, geothermal, solid waste, hydroelectric, and wind.

Only solid waste and solar energy would be available in a large enough supply to be feasible as alternate municipal sources.

The second part of the project attempted to establish a relationship between energy consumption and urban dynamics.

Questionnaires were distributed to gather information from a city wide area, while face-to-face interviews were conducted in a specific part of Waco that represented the growth stages of the city.

Energy consumption, cultural data, and opinions were gathered on the following topics: Income, education, employment, heating and cooling systems, appliances, conservation, automobiles, mass transit, family size and ages, energy crisis, and nuclear power.

The interview results were stored on computer tape and matched with electricity and natural gas consumption figures obtained through the utility companies.

Reference copy: Moody Memorial Library, Baylor University.

****

Development of an Electrical Impedance Plethysmographic Arterial Function Test (Grant no. GY-11514)

Worcester Polytechnic Institute
Worcester, Massachusetts 01609

June 10, 1974 - August 30, 1974

Participants:

Robert Canova	Robert Martin
William Cunningham	Bill Penney*
Carl Ferreira	Richard Perreault
Bruce Haffty	Carl Tracy

Sue Witkie

*Student Project Director

Non-Stipend Participant:

David Lapre

Robert Peura, Faculty Advisor

Hardening and narrowing of the arteries is a common condition which becomes worse with advancing age. When it is of such severity that it hinders blood flow, surgical correction may be desirable. To develop a test which would quantify the degree of flow obstruction and which would be acceptable to the patient and to the physician was the goal of this study. A non-invasive technique of monitoring volume changes, electrical impedance plethysmography, was chosen because it is convenient, non-traumatic, and can be easily applied at the bedside.

Three students with life science backgrounds devised a patient test procedure to evaluate the diagnostic value of four impedance plethysmographic parameters. The heart synchronous impedance signal from resting patients and from normal volunteers was objectively characterized by three slopes, three amplitudes, and three time durations. The slope of the impedance signal during venous occlusion was also measured. Both parameters were determined after the induction of a large demand for blood flow by occluding the arteries for three minutes. The resultant 20 parameters were statistically analyzed. Two parameters were shown to separate the two populations tested significantly; the normal volunteers and the patients shown by arteriography to have narrowing of the arteries leading to the calf. The maximum increasing systolic slope and the maximum decreasing systolic slope had diagnostic accuracies of 90% and 92% respectively, in the population of 12 abnormal and 14 normal limbs. The optimum dividing lines determined for the impedance slopes were 0.49%/sec and 0.18%/sec, respectively. These impedance recordings were made using four circumferential electrodes on the calf.

This result was dependent on the development and evaluation of an instrumentation system by a group of three students with engineering backgrounds. A system for adequate display and storage of the desired impedance signals was developed. An electronic frequency filter was implemented to allow display of the arterial pulsations without undue drift from respiration. This was a second order filter with a natural frequency of 0.1 Hz and damping ration of 0.5. They developed techniques for determining how valid past criticisms of impedance plethysmography were in this particular application and demonstrated that the impedance signal accurately reflects changes in tissue impedance.

A student of psychology conducted interviews with physicians, observed patient testing in 11 hospital laboratories, and determined equipment costs in these laboratories. For the hospital administrator to consider the test comparatively cost-effective, the impedance test equipment must be purchased for less than about $5000. A test which lasted more than 20 minutes or that caused prolonged pain was not well accepted by patients. The physician's acceptance was found to depend on the accuracy of the test in measuring diagnostically valuable physiological variable. The test developed met these acceptability criteria except for the lack of a clear physiological interpretation of the two significant parameters.

Three studies were conducted to establish this needed interpretation. Using pneumatic cuffs, controlled occlusions were created on normals and the changes in the pulsitile waveform observed. A physical arterial model was constructed and the effects of varying lengths, compliances, and resistances observed. A theoretical model was computer implemented by two students and the pressures and flows at various points in the arterial system were predicted. These studies indicated that the differences noted between the impedance parameters of normals and abnormals could be explained in terms of the increased arterial resistance and the decreased peripheral resistance expected in an abnormal.

Reference copy: Worcester Polytechnic Institute Library

****

Actions of Compounds that Act as Post-Irradiation Chemotherapeutic Agents (Grant no. GY-11429)

Austin College
Sherman, Texas 75090

June 3, 1974 - August 23, 1974

Participants:

Celina I. Bustos
David P. Capper
Robert E. Clark
Preston C. Conrad
Gary M. Dunn
Susan L. Jeffers
Bill B. Lofland
Jerome J. Murphy

Larry J. Paulk*

*Student Project Director

Charles P. Olander, Faculty Advisor

Investigations into the actions of certain compounds that act as post-irradiation chemotherapeutic agents were made. Specifically, the hematopoietic (blood forming) system would be treatable for exposure to ionizing radiation. The project involved both in vivo and in vitro studies of these compounds. The major compound under investigation was sodium hexachloroiridate.

In vivo investigations were divided into two groups, hematological indices and lethal irradiation, survival studies. Data were gathered on six hematological parameters in rats (RBC, WBC, Hb, Hct, MCV, and MCHC) so as to establish any dosages of the compound that had a pronounced effect on the blood system. There were no observable effects of the iridium compound on the blood system at concentrations between the ranges of $10^{-6}\underline{M}$ and $10^{-3}\underline{M}$. A concentration of $10^{-2}\underline{M}$ proved fatal to animals presumably because of cytotoxic effects.

Survival studies were carried out in mice which had received 850 Rads (whole body) from a Co-60 source. A variety of concentrations was tested. Those animals receiving the iridium compound at a concentration in the range of $10^{-4}\underline{M}$ - $10^{-3}\underline{M}$ exhibited a mean survival time (MST) of 18.8 days, while the control animals had a MST of 7.7 days. Thus, the compound extended the survival time of the lethally-irradiated animals by better than a factor of two. A spleen colony assay was also employed as a measurement of erythropoietic activity in the lethally-irradiated animals. Although not statistically significant, those animals receiving the compound showed a higher level of erythropoiesis than controls. Localization of the compound *in vivo* was carried out by administering the isotope of the compound, ^{192}Ir. Results indicate that the spleen is the only organ which accumulates and retains the compound over an extended period of time.

The aim and purpose of the *in vitro* study was to investigate the molecular mechanisms of action of the chemotherapeutic agent, iridium, with special emphasis on monitoring of DNA synthesis, heme synthesis, and cell kinetics *in vitro*. Such data were obtained by the *in vitro* culturing of heterogeneous rat bone marrow cells in the presence of 5-[^{125}I] Iodo-2' - deoxyuridine for 24 hours and then with the subsequent addition of ^{59}Fe 4 hours before termination of the culture experiment. These double labeling experiments thus provide simultaneous measurements of DNA and heme synthesis, as determined on a well-type solid scintillation counter. To determine if the culture system is indeed reliable, several dose response experiments were performed. From these experiments it was found that a linear relationship existed between the $\log_{10}$ [EPO] (EPO=erythropoietin) and the incorporation of ^{59}Fe labeled heme, demonstrating that the culture system was both efficient and reliable. Further support for this observation comes from the fact that Goldwasser, 1963 has shown that a linear relationship exists in the range of 10mU-2,000mU of EPO which contains the portion of the line reproduced during the project.

Dose response experiments were performed in order to determine the least concentration of Ir necessary to inhibit DNA synthesis and heme synthesis significantly. Iridium at $10^{-3}\underline{M}$ proved to be the most successful concentration meeting these requirements. Cell kinetic studies show that $10^{-2}\underline{M}$ Ir is possibly cytotoxic and $10^{-4}\underline{M}$ did not adequately alter DNA synthesis or heme synthesis. Both DNA synthesis and heme synthesis followed the same sort of inhibitory responses or pattern.

To determine and characterize the inhibitory effects of Ir on DNA synthesis and heme synthesis, Ir was compared to hydroxyurea (HU), an inhibitor of known action. In the following table a comparison of the inhibitory effects of iridium and hydroxyurea on DNA synthesis is presented.

COMPARISON OF THE INHIBITORY EFFECTS OF IRIDIUM AND HYDROXYUREA ON DNA AND HEME SYNTHESIS

Percent Inhibition*			
Heme		DNA	
Iridium	Hydroxyurea	Iridium	Hydroxyurea
38.48 ± 15.95 n=45	78.76 ±21.59 n=15	Extremely variable n=45	210.00 ±146.00 n=15

*As calculated by the technique of Paul and Conkie (1973).

From the table, the percent inhibition of DNA synthesis by $10^{-5}\underline{M}$ hydroxyurea is both marked and consistent. Furthermore, with increasing concentrations of EPO (10mU-100mU) added to cultures containing $10^{-5}\underline{M}$ HU, DNA inhibition is maintained and not released. Iridium exhibits quite a different effect. First, the response of DNA synthesis to $10^{-3}\underline{M}$ Ir is extremely variable and shows no consistent pattern, and secondly, with increasing concentrations of EPO (10mU-100mU) added to cultures containing $10^{-3}\underline{M}$ Ir, DNA synthesis inhibition is released in step-like fashion with percent inhibition decreasing over control. Concerning HU, these findings are consistent with findings in the literature, substantiating the mode of action of HU as an effective DNA synthesis inhibitory agent. Additionally, preliminary results of a different type show that Ir is not only incorporated into ethanol extractable DNA, but Ir is also incorporated into the TCA precipitable fraction of polymerized cellular materials. This indicates that Ir may not act only on the nuclear constituents of the cell, but possibly at the cellular membrane location also. The data concerning Ir serve to demonstrate, in lieu of the extreme variability of inhibitory responses, that the mode of action of Ir as an inhibitory agent of DNA synthesis is quite complex and involves a much more sophisticated mechanism than previously thought.

With respect to the percent inhibition of heme synthesis, $10^{-5}\underline{M}$ HU is only about twice as effective as $10^{-3}\underline{M}$ Ir, so both compounds are relatively good inhibitors. The most significant finding arising from the heme synthesis comparisons is the with increasing concentrations of EPO (10mU-100mU) added to cultures with $10^{-5}\underline{M}$ Hu, the inhibitory effect of HU is progressively released. Thus, with additions of high doses of EPO (100mU) with $10^{-5}\underline{M}$ HU, DNA synthesis can be inhibited and protein or heme synthesis remains unaffected or slightly stimulated. Two basic conclustions arise from this work: (1) Ir and HU do not have the same mode of action, and probably Ir works through a much more complicated mechanism; (2) The feasibility of HU as a post-irradiation chemotherapeutic agent should be investigated.

Reference copy: Library of Austin College

****

Cleaning Coal with Coal (Grant no. GY-11447)

University of Missouri
Columbia, Missouri 65201

June 3, 1974 - August 23, 1974

Participants:

Rex L. Berney	David R. Jones
Robert C. Brown	Philip L. Knutson
Bruce D. Davis	Charles M. Pross
John B. Green	Michael R. Sante
Sandra J. Harlan*	William Allen Smith
Lee O. Isselhardt	John R. Tenny

*Student Project Director

S. E. Manahan, Faculty Advisor

In light of the recent concern over the development of new and substantial energy sources for the future, the possibility of discovering a relatively simple and effective means of treating our existing abundant supplies of coal becomes more and more attractive.

Because of the highly complex chemical nature of coal itself, the possibility of preparing a treatment material from coal arises. The object of this research project was the preparation of ion-exchange materials from coal humic acids and their application to cleaning up several different systems derived from the utilization of coal as a fuel.

Four areas of investigation are represented in the report from the project, including coal particle-metal interactions, soluble humate-metal interactions, humate interactions with SO_2 and NO_2, and coal particle and plant interaction.

The first of these areas describes the preparation of a material from coal which is capable of removing heavy metals and acidity from aqueous solutions. This material is prepared by a partial oxidation of coal which leads to the formation of a film of regenerated humic acids, derived from the oxidation of coal, which is deposited on the surface of the coal particles. Further studies with this substance demonstrated its utility for the removal of heavy metals and acidity from aqueous solutions.

Also investigated in this section of the project was the natural ion-exchange behavior of several different types of coal materials, such as lignite and leonardite, and the application of these materials to a specific problem associated with the utilization of coal, acid mine water.

Another aspect of the investigations concerning these coal particles was their characterization before and after ashing, using neutron activation analysis. This study led to a better understanding of the composition of the coal material, in light of mineral inclusions, etc.

The second area of research involved the preparation of a base soluble substance, coal humate, which has an increased capacity for heavy metal and acidity removal, as well as the flocculation of particulate matter. This product is very valuable as a potential treatment for stack gases, since it can remove metals and acidity, as well as flocculate and entrap any particulate matter present as it becomes increasingly acidic.

In this section, the specific acidity removal properties of the soluble humate were investigated, as well as the kinetics of metal uptake by the humates. It was demonstrated that this product had approximately two orders of magnitude greater sorptive powers towards metals than did the coal particles prepared in the first section of this project.

All indications are that this product has a great potential as a treatment medium, especially for treating stack gases evolved from coal fuel power plants.

The third area of investigation specifically involved the sorption of SO_2 and NO_2 by soluble coal humate. These humates seem to very promising for the removal of these two gases associated with the burning of coal, and not only can the humates be regenerated, but they also show an increased affinity for the absorption of these gases after their first exposure.

The last part of the investigation involved the study of the interactions of plants with the coal humate saturated with metal, as well as unsaturated. This type of study is important in the event that this expended coal material was disposed of in a landfill operation, or possibly used as a fertilizer. Plants (in this case, corn and radishes) were grown in controlled environments. It was an objective of this portion of the research to determine whether or not plants would take up metals from the coal humate, or whether the humate would bind the metals tightly enough to prevent this metal uptake. From the results of this portion of the study, it was seen that the plants did show an increased uptake of metals from the humates, but not enough to abandon the possibility of using the expended coal materials as described above.

The metal analysis for half of this portion of the project was done by atomic absorption analysis, while the second half was done by x-ray fluorescence spectroscopy.

Reference copy: University of Missouri - Columbia Library

****

Pneumatic Conveyance of Dry Feedlot Manure in an Energy Recovery System (Grant no. GY-11457)

Iowa State University
Ames, Iowa 50010

June 3, 1974 - August 25, 1974

Participants:

David T. Barr*
David W. Beck
Debby Hindus
Benedict S. Ho
Marlin W. Reimer
Brian R. Strub
Hendra Wijatno

*Student Project Director

Richard J. Smith, Faculty Advisor

Animal manure is a residue having potential use as an energy source. Fattening beef animals produce the greatest amount of manure of any species of animal kept by man. Currently, there are about 14 million cattle in the United States' feeding operations, producing a total of 700 million pounds of waste every day. This presents a tremendous waste-disposal problem, having great potential to pollute surface and ground water and to help spread human and animal diseases.

Currently, there are four processes by which energy can be recovered from cattle manure: pyrolysis, anaerobic digestion, incineration, and conversion to oil by hydrolysis. The net energy available from each of these processes is about 2×10^9 ft lb/ton. This means that 10,000 megawatts of power are available in the nation's cattle manure. Because these processes require high initial investment, centrally located plants of large capacity are likely to be favored. The economic success of the energy-recovery system may, therefore, depend largely on transportation costs. This study investigated the characteristics of a pneumatic system for conveying cattle manure and determined the energy requirements of such a system.

A 1-1/2 ton sample of manure was obtained from a central Iowa concrete open feedlot and hammermilled to obtain a particle size less than 0.2 inch. To determine experimentally the characteristics of the pneumatic conveying system, a straight horizontal pipeline, 90 ft. long, was constructed. This pipeline consisted of 2-, 3-, and 4-inch diameter aluminum pipe, placed alternately. A rotary positive displacement blower, attached at the head of the pipeline, supplied the air pressure needed to transport the manure. The manure was fed into the pipeline downstream of the blower through a rotary airlock, preventing pressure loss. Six U-tube water manometers mounted along the pipeline were used to monitor the pressure drops along the pipe. The manure was collected in a container that rested on hydraulic load cells, facilitating discharge measurements. Although all three pipe diameters were investigated, most of the data were obtained using a 3-inch pipe because it best matched the blower characteristics.

Two types of experimental data were taken: one measuring pressure losses along the pipeline and the other measuring the minimum velocity needed to convey the manure under varying transport conditions.

A dimensional analysis of the experimental pneumatic transport system indicated that three dimensionless groups were needed to characterize the system: a pressure coefficient, $\frac{\Delta pD}{\rho_f v^2 L}$, Reynolds Number (Re) $\frac{\rho_a vD}{\mu}$, and a density ratio, $\frac{\rho_f}{\rho_s}$. The pressure coefficient was found to decrease as Reynolds Number increased to 6×10^4. Above an Re of 7×10^4, the pressure coefficient was insensitive to changing Reynolds Number, remaining essentially constant. The pressure coefficient also decreased for increasing values of the density ratios, becoming constant at $\frac{\rho_f}{\rho_s}$ values greater than 7×10^{-3}.

Minimum conveying-velocity tests showed two regimes of conveying efficiency, with air velocities above a transition region of 37-49 ft/sec having a higher conveying efficiency than velocities below the transition region.

The minimum energy requirement for the system is 7.1×10^7 ft lb/ton mi, and occurs for Reynolds Numbers between 5.0 and 6.5 $\times 10^4$. Hammermilling the manure consumed 2.8×10^7 ft lb/ton. Therefore, when used in conjunction with an energy-recovery process that produces 2×10^9 ft lb net energy per ton of dry manure, pneumatic transport systems up to 27 miles in length are possible, while still obtaining net energy from the combined transport and recovery system.

Definition of Symbols

D	pipe diameter	ft
$\frac{\Delta p}{L}$	pressure drop along pipe	$\frac{\text{lb/ft}^2}{\text{ft}}$
v	air velocity	ft/sec
μ	air viscosity	$\text{lb}_m/\text{ft sec}$
ρ_a	air density	lb_m/ft^3
ρ_f	fluidized (air and solids) density	lb_m/ft^3
ρ_s	solid particle density	lb_m/ft^3

Reference copy: Agricultural Engineering Department, Iowa State University.

****

Energy Consumption and Social Interaction in Mobile Home Parks, Champaign County, Illinois (Grant no. GY-11424)

University of Illinois at Urbana
Urbana, Illinois 61801

June 1, 1974 - August 24, 1974

Participants:

Rodney Clough
Nancy Fuchs
La Verne Hanson, Jr.

William Monk
Steven Parshall*
Kenneth Wilson

*Student Project Director

Jeffrey Marcowitz Michael Wolfson
Patrick Maritz Gideon Vigderhous
Wolfgang F. E. Preiser, Faculty Advisor

Configuration, defined as the spacing relationship for groups of mobile homes with reference to the park road, is often manipulated by designers as a conceptual representation of mobile home park schemes. Configuration type, configuration location, unit position within a configuration, and unit orientation were the study's major independent variables. Answers were sought to these questions: how are variations in (1) social interaction, and (2) energy consumption dependent on the configuration of mobile homes? From the investigation six criteria are suggested for the design or improvement of mobile home parks.

The study was structured by an environmental model with one axis as the scale of observation (county, park, and unit), and the other axis as the systems of information (typology, social, energy). Connecting the park scale and the unit scale, configuration was the unit of analysis for relationships among a particular system of dependent measures. The types of physical settings, for the 74 registered mobile home parks in Champaign County, were described and classified through various aerial photographic and field inspection techniques. From the typology of county parks, a sample of 14 was designated for evaluation of social interaction. A questionnaire, administered to 200 residents, measured: (1) friendship formation; (2) perceived privacy; (3) noise disturbance; (4) satisfaction with yard space; (5) satisfaction with park facilities; and (6) overall residential satisfaction. Mapping questions were asked (1) to determine distancing of friends; and (2) to identify preference for lot locations. Energy requirement variations for (1) unit type; (2) orientation; (3) enclosure or exposure of site characteristics; (4) configuration location; and (5) park layout were simulated by mathematical models, and a descriptive case study was made of the park sample.

Results were synthesized into six suggested design criteria. To improve social interaction we suggest:

1. Any design feature of the park or lot space that increases perceived privacy or increases the usability and/or satisfaction of one's individual lot should facilitate overall residential satisfaction.
2. Residents living in radial configurations (units arranged along a curvilinear axis) reported having more friends, greater perceived privacy, and greater satisfaction with their yard spaces than did residents of other configurations. It is hypothesized that radial configuration possesses certain inherent characteristics, for instance, lot shape and orientation of units, that tend to maximize privacy and increase the usability of yard space.
3. Residents overwhelmingly preferred lots located on the edges of a park and on the ends of rows. This suggests park designs which seek to maximize perimeter length and number of end of row locations which can increase the residents' satisfaction with their lot location.

To optimize energy consumption we suggest:

1. Comparatively, newer mobile homes models are more energy efficient than older models. This is due largely to the use of glass on one side of the unit. When the long side faces a southerly direction, the mobile home benefits from solar heating during winter time. Where southerly orientation is not feasible because of topography, park improvements (such as planting shade trees and erecting wind breaks) must be considered.
2. The mobile home must be considered as a building type which requires minimum excavation. This feature raises problems of energy efficiency over the long term. Excavated pads, decking and shade trees surrounding the unit are examples of how the mobile home can become more energy efficient.
3. Optimum orientation of a unit is related to the characteristics of its environment. This requires re-thinking the park site as directly affecting the energy efficiency of the mobile home. The addition of wind fencing, shade trees and edge foliage, when installed to work with the site, can enhance site characteristics and allow more flexibility in park layout.

Reference copy: Ricker Library, University of Illinois at Urbana

****

The Design, Construction and Testing of Solar Energy Utilization Devices (Grant no. GY-11539)

Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

June 3, 1974 - August 31, 1974

Participants:

John Brookes
David Hawke
Robert Ivanhoe
Masayuki Karakawa
Paul LaViolette
Bruce Markow
Kevin McCarthy*
Jay Nadelson
Grace Papia
Wilfred Veldkamp

*Student Project Director

George Pratt, Faculty Advisor

It is becoming increasingly clear that energy resources derived from fossil fuels are nearing depletion. While nuclear fission and fusion hold promise for supplying our future needs, solar energy is an immediately available resource which can be of great help in providing the 22% of United States' energy consumption now used for home and space heating. The technology needed is already available, and, with proper development could meet a large portion of our space heating needs.

In this study we focused our attention on three areas of solar thermal research. The first of these dealt with selective radiation surfaces. Considerable work has been done on selective blacks, that is, surfaces which appear black to incoming sunlight while maintaining a low emissivity in the infra-red. However, little attention has been paid to transparent selective surfaces - that is, ones which are transparent to incoming sunlight while behaving as a mirror to outgoing infra-red radiation. We found that a transparent semi-conducting film, tin oxide, when doped with the appropriate compounds, forms an excellent 'heat mirror'. These films were produced in the laboratory by means of chemical vapor deposition, and were found to increase collector performance by as much as 30%. A study of cost-effectiveness, using a similar film produced by a commercial firm, indicated a cost in the neighborhood of $.70/sq. ft., which is significantly competitive for selective blacks in combatting radiative losses.

Another area of study was in numerical simulation of the solar heating system. Using the well known correlations between the differential equations of thermal and electrical systems, we wrote the solar heating system as an equivalent electrical circuit. This was then set up on a computer, using reasonable assumptions for various physical parameters and allowing the others to vary with respect to time. Much useful information was obtained regarding storage tank size, relative placement of insulation, auxiliary heaters and their location, and the effects of varying solar input.

A third aspect of our research lay in the area of focusing collectors. One such receiver, utilizing multiple reflective cylinders, was optimized and built, yielding an overall efficiency of 38% at a materials cost of $1.00/sq. ft. It was shown that the refractive equivalent, a cylindrical fresnel, would perform better and an analytical optical study resulted in a general equation for design of such lenses. A prototype was built which achieved high efficiencies.

Infra-red instrumentation was designed and built which could detect a cigarette at 1/4 mile. The applications of imaging to solar energy were studied, and while purchase of a thermographic camera was beyond the funding of this study, it is felt that this is a promising new field to be developed.

Finally, convection in gaseous and liquid media was studied. An inexpensive means of defeating convective losses in solar panels while leaving solar absorptance unchanged was developed. A schlieren analysis of heat loss resulted in suggestions for inexpensive control of surface losses from solar collectors.

Reference copy: Massachusetts Institute of Technology Science Library

****

Neurometabolism of L-Glutamic Acid (Grant no. GY-11428)

Ripon College
Ripon, Wisconsin 54971

June 3, 1974 - August 23, 1974

Participants:

Thomas H. Broman	Daniel J. Minnema*
Dorn W. Carlson	Floyd A. Warren
Martha D. Milikowski	Michael H. Zehfus

*Student Project Director

Richard G. Scamehorn, Faculty Advisor

Glutamic acid, a neuroexcitor, plays a key neurometabolic role. This is evidenced by the large concentrations of this amino acid found in the brain. Recently it has been shown that the mono-sodium salt of glutamic acid (MSG), found in many popular foods, has resulted in the formation of brain lesions when administered to neonatal animals. By sacrificing neonatal and adult rats at different time intervals after the administration of ^{14}C-glutamic acid, and by incorporating extraction, separation, quantification, scintillation, and autoradiographic techniques, the research team was able to determine that glutamic acid is much more rapidly metabolized in the adult animal than in the neonatal animal, although no histological location for this process could be determined. This difference in metabolic rates in different age animals explains, in part, the neurotoxic effects associated with MSG.

Reference copy: Ripon College Library

****

An Investigation of the Bacterium, Hydrogenomonas, as a Protein Supplement for Animal Consumption (Grant no. GY-11439)

Catholic University
Washington, D. C. 20017

June 3, 1974 - August 23, 1974

Participants:

Peter Andrews	Patricia Kruczak
Marianne Angel	Irma Liu
Michael Dellarco	Kevin Murphy
Marion Ficke	Carol Nacy-Mahady*

Gregg Van Gundy

*Student Project Director

Benedict T. DeCicco, Faculty Advisor

Recent projections of the energy crisis have indicated the need to evaluate conventional methods of transportation, food consumption, and recreation, critically. One of the most important aspects affected by an energy shortage in terms of human existence is the quantity and quality of food available for consumption. This project attempted to evaluate an unconventional and largely ignored source of protein, single cell protein. The bacterium, Hydrogenomonas, was chosen for several of its unique attributes: it is a chemolithotrophic autotroph which derives its energy from hydrogen and is capable of manufacturing all compounds necessary for its existence from carbon dioxide and a few inorganic salts. Hydrogen can be generated electrolytically from water, allowing the bacterium to be grown in a chemically defined system consisting essentially of water. This eliminates the possibility of incorporating carcinogenic compounds potentially found in several of the substrates previously investigated for production of single cell protein.

The mass culture of the bacteria proved to be rather difficult without the aid of elaborate and enormously expensive equipment. After several weeks of struggling with design requirements, the students were able to increase, but not maximize, the number of bacteria harvested by increasing aeration. It was decided at this point to limit the investigation to those strains that grew well in the system as designed, namely Hydrogenomonas eutropha (HEW) and Hydrogenomonas texanii (TEX). The cells were separated from the spent medium on the third day after inoculation by a Virtis de Laval cell separator. Half the yield of each strain was subjected to a three step heating process in an effort to reduce the

RNA content by endogenous enzymes; the cells were boiled to remove viable cells and lyophilized. Approximately 190 grams (dry weight) H. eutropha and 183 (dry weight) H. texanii were subsequently produced for biochemical, nutritional and immunological studies.

Biochemical analysis of the Hydrogenomonas strains consisted of the following tests:

-1- Lowry test for protein

-2- Kjeldahl analysis for total nitrogen (converted into % protein)

-3- Orcinol reaction for RNA

-4- Diphenylamine reaction for DNA

-5- Phenol test for carbohydrates

-6- Lipid analysis by method of Low and Slepechy

The results of these tests for each of the strains are contained in the following table:

BIOCHEMICAL ANALYSES OF HYDROGENOMONAS STRAINS: % OF CELL

	PROTEIN		RNA TREATMENT		DNA	CARBO-HYDRATE	LIPID
STRAIN	LOWRY	KJELDAHL	PRE	POST			
HEW	72.8	64.75	9.88	1.35	2.03	8.5	*
TEX	62.4	76.4	8.77	2.31	2.1	9.3	*

*lipid analysis unsuccessful; unable to obtain hydroxybutyrate in anything other than its naturally occurring salt form

The reduction in endogenous RNA by the heating process was both surprising and gratifying. The process has been successfully applied to yeast cells which are eukaryotic, but has not been reported as successful in prokaryotic cells.

The significance of this finding lies in the reduction of compounds that could form uric acid, a compound with potential to produce gout in humans if formed in sufficient quantities.

The high percentage of proteins in both strains, as demonstrated by Lowry and Kjeldahl analysis, indicates the suitability of using these organisms as a protein supplement. This was confirmed by the nutritional studies performed with mice.

Twenty randomly bred white male mice (less than 20 grams) were placed on a low protein diet containing 5.4% protein for one week. At the end of this period, the mice were assigned on a matched-weight basis to four dietary treatment groups:

-1- Low Protein Diet: basal diet + 5.4 % protein from casein

-2- Casein Diet: basal diet + 33.5% protein from casein

-3- TEX Diet: basal diet + 27.3% protein from _H_. _texanii_

-4- HEW Diet: basal diet + 25.4% protein from _H_. _eutropha_

Because of the limited amount of bacteria, the test diets were fed for five days only. Urine, feces, and rejected foods were collected for the last three days of the test period and analyzed for nitrogen content by Kjeldahl analysis for total nitrogen. Records were maintained of the weight gain for each group; because the % protein differed slightly for the three test groups, the weight data was normalized by maintaining the mice on a 20% casein diet for three weeks after the testing period.

Nitrogen digestibility and biological value of the protein were computed according to the method of Mitchell _et_ _al_. using the following factors:

NI : Nitrogen Intake, mg

FN_m : Fecal Nitrogen of Low Protein Diet Group, mg

FN_t : Fecal Nitrogen of test group, mg

UN_e : Urinary Nitrogen of Low Protein Diet Group, mg

UN_t : Urinary Nitrogen of test group, mg

Absorbed Nitrogen (AN) = $NI - (FN_t - FN_m)$

$$\text{Biological Value (BV) \%} = \frac{AN - (UN_t - UN_e) \text{ X } 100}{AN}$$

The results of the analysis of the nutritional data have been compiled into the following table:

STRAIN	BIOLOGICAL VALUE(%)	DIGESTIBILITY(%)	NET UTILIZATION (%)
HEW	89	95	84.6
TEX	90.5	97.5	88
CASEIN	81.1	100	81.1

The proteins of *H. eutropha* and *H. texanii* were analyzed for amino acid patterns using various microbiological assays for specific amino acids. Of critical importance were the amino acids, lysine, methionine, threonine and cysteine; these amino acids cannot be synthesized by the mouse and must be supplied for normal growth. The same amino acids have been found to be absent in most forage crops, meat and blood by-products, and grains, the main sources of food for animal production. The amino acids that were analyzed and the results for each strain are contained in the following table:

mg Amino Acid per 50 mg Calculated Protein
as Determined by Microbiological Assay

AMINO ACID	HEW	TEX	CASEIN
Cysteine	1.21	0.61	0.34
Lysine	*	*	*
Methionine	4.23	13.07	13.70
Threonine	19.08	10.15	7.2

*Standard curve for Lysine gave variable results; no two assays were comparable.

Microbiological assay was also used to assess several of the B vitamins. Significant amounts of riboflavin, niacin, thiamine, pantothenate, biotin, and nicotinic acid were found in both strains.

Endotoxin is a natural component of gram negative bacterial cell walls and is composed of lipopolysaccharides. Since Hydrogenomonas are gram negative bacteria, the immunology section attempted to determine the toxicity of the endotoxin contained in the whole-cell preparations used in the nutritional studies. The toxicity would only be a factor in feeding humans single cell protein, as other animals seem unaffected by the endotoxin.

The endotoxin from each strain was extracted successfully by the Luderitz method, a modification of the classical Westphal method of lipopolysaccharide extraction. the LD_{50} determination for each strain was, however, unsuccessful. It is our belief that this project contributes significant background information on single cell protein, a rapidly produced, constant, and inexpensive source of protein for animal and eventually human consumption.

Reference copy: Biology and Chemistry Libraries, Catholic University

****

Malnutrition and Brain Function in the Developing Animal

(Grant no. GY-11473)

Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

June 3, 1974 - September 2, 1974

Participants:

Michael Arnold

Douglas Faller

Laurel Fisher

Barbara Greenberg

Marc Levin

Jack Liebschutz

Mark Nelson *

Doris Taam

*Student Project Director

John D. Fernstrom, Faculty Advisor

The basis level of serotonin, a neurotransmitter, has been shown to depend on the dietary availability of its amino acid precursor, tryptophan. Tryptophan has also been shown to be rate-limiting for protein synthesis in the adult rat. Since certain human sub-populations subsist on grains notoriously low in tryptophan, e.g., corn, we decided to investigate the effects of long-term ingestion of such a diet on brain serotonin and other biochemical and behavioral parameters believed to be mediated by serotonin. We were also interested in determining whether or not any observed changes could be dietarily reversed.

Using the male laboratory rat as our experimental subject, we determined that chronic ingestion of a corn-based diet produced rapid and significant decreases in brain tryptophan, serotonin and 5-hydroxyindoleacetic acid. Brain dopamine and norepinephrine, two other neurotransmitters, and their amino acid precursor, tyrosine, were also rapidly and significantly reduced. Plasma and pituitary growth hormone levels were also readily reduced by our dietary manipulation. All of the above compounds were readily repleted, however, after dietary rehabilitation. When compared with control animals, the capacity for protein synthesis in the brains of cornfed animals did not appear to be impaired. Insulin levels in blood were lower in corn-fed animals, but the insulin response to a load of dextrose was proportionally similar to that of control animals. Locomotor activity also appeared to be altered in corn-fed animals.

Reference copy: Hayden Library, Massachusetts Institute of Technology

****

The Study of the Feasibility of Anaerobic Digestion for Farm Use (Grant no. GY-11445)

University of Wisconsin at Green Bay
Green Bay, Wisconsin 54305

June 1, 1974 - September 16, 1974

Participants:

Pamela Atkinson*
Gene Beteille
Bill Casey
Karla Dykes
David Freedman
Michael Gallagher

Bruce Hottum
Edwin Kaehler
William Marsh
Heidi Nelson
Timothy Rowe
Eleanor Schrader

*Student Project Director

Tom Abeles, Faculty Advisor

The project objective was to assess the feasibility of anaerobic digestion for farm use in Northeastern Wisconsin comprehensively. Anerobic digestion was looked upon as a farm waste manangement practice with the following benefits setting it apart from standard manure handling practices:

A. A digested slurry which has the possibilities of being used as:

   1. a high grade fertilizer for farms;

   2. a basis for aquaculture or algae production;

   3. a high grade fertilizer for sale to growers of produce and the general public.

B. Methane gas which serves as a high grade fuel for direct consumption on the farm or resale.

To serve this purpose three steps were taken:

1. A 212 cubic foot digester was built on a farm adjacent to UWGB;

2. Studies were pursued which make use of small scale laboratory digesters as tools for preliminary research and analysis of anaerobic digestion feasibility;

3. Sociological conditions and the economic situation existing within the surrounding farm community were examined as they relate to the feasibility of anaerobic digestion.

In designing the farm digester we looked initially toward a typical Wisconsin dairy operation as the location for our anaerobic digestion system. However, as our understanding of farming in Wisconsin grew, we determined that the complexity of our project would place an unnecessary burden on the efficiency of operation on a real farm. A typical Wisconsin farmer cannot, at this point, afford to assume such a cost. The above factors, coupled with recognition that we would be extending our resources at the expense of our prime objectives, made us decide to opt for an alternative which would stay closer to the limitations of our time, finances, and talents.

This involved, first, a scaledown of our designs for handling the wastes for 30 head of cattle to a more manageable size system for three cows. A two stage, gravity feed system with gas percolation used to achieve agitation was proposed. However, the consistency of the wastes that we are subjecting to digestion provided little assurance that such a system would prove functional. There was a likelihood that problems with pipes clogging and undesirable stratification within the digester might occur.

Therefore, the design continued to evolve with a system finally being determined whose engineering specifications held reasonable promise of successful operation. A sewage pump, hot water heat exchanger, precast concrete tank, and a 55 gallon mixing hopper were incorporated as integral components of the system. Also, accessibility was increased by having all fittings brought through the top of the digester with the heat exchanger, pump, and pipes being housed in an insulated building above the tank. Thus, fittings could be checked, leaks detected, and modifications could be made with comparative ease.

The actual digester construction got underway by mid-July. The digester's start up was unexpectedly delayed pending the arrival of the circulating pump which was shipped late because of a shortage of steel.

The first laboratory thrust was in the direction of refining the design features of small scale, laboratory digesters. Batch digesters which were used previously were modified for continuous feed operation, with special ports being incorporated to allow for further and more accurate monitoring of the gas evolution and microbial activity. These digesters were subjected to conditions intended to simulate, as near as possible, the eventual modes of operation to be used with the prototype farm anaerobic digester and the kind of analytical observations that would be made. The methods that were used had been adapted from either standard methods, or by a process of identification and manipulation of these standard methods to the degree necessary to fit our requirements. Pertinent microbial examination and chemical analyses were performed on two systems that were kept under identidal environmental conditions and differed only by the rate of retention of the manure slurry. Within the available time, a stable digester operation was not achieved, but valuable confirmation of reported findings in gas production and composition, microbial succession and interactions were made.

Soil studies were undertaken to deal with the effects of nitrogen transformations that occur in the anaerobic digestion process in order to assess its value as a fertilizer. This entailed an initial literature review followed by quantitative laboratory experiments. The preliminary investigations that were performed included:

1) Fifteen test plots which were 28 square feet in total surface are were set up to measure the surface runoff of inorganic nitrogen relative to the application of manure from three different methods of manure handling including anaerobic digestion, liquid, and stacked manure handling systems;

2) Another experiment was designed to measure the relative amount of ammonium nitrate in manure before and after digestion;

3) An experiment to study nitrogen availability to plants from fresh manure as compared with anaerobically digested manure was set up using a Stanford-Dement Bio-Assay Test.

The first experiment, measuring the surface runoff of inorganic nitrogen provided us with only variable data which were not sufficient for meaningful correlations to be made. Our main problem was obtaining controlled conditions. Exact replications of each plot that was set up were not possible because of the varied composition of the soil in the test area. We also found that insufficient amounts of manure were used which was indicated in the test by low parts per million values of inorganic nitrogen. This compounded the problem of correlation of data. Our conclusion was that for visible tests results greater quantities of manure would have to have been used on the test plots.

Measuring NH_4-N in manure before and after digestion revealed a high concentration in manure after digestion.

Within the realm of sociological and economic matters, five functional roles served as important links with the farm community's interest and concerns. These were:

1) The writing of a pamphlet briefly describing anaerobic digestion;

2) The preparation of a survey to be used in amassing a data base that can give insights into the operation

of local farms and cast light upon the receptiveness of area farmers to innovative ideas;

3) The conduct of a follow-up personal interview with area farmers who were chosen from a cross-section of the farm population as it was classified by dairy herd size;

4) The furnishing of preliminary projections on the economic feasibility of various size anaerobic digesters;

5) Communicating with the community vis-a-vis the media and appropriate channels of farm information distribution.

The pamphlets were sent out to eighty farmers who were identified with the assistance of the Wisconsin Dairy Herd Improvement Association. These farmers were subsequently interviewed. Two indications prior to the analysis of this data are evident: the most prevalent manure handling system in Brown County is daily hauling; and the answers to questions regarding anaerobic digestion showed some marked interest in the study.

The economic indications are that anaerobic digestion is not feasible in our area at the present time. However, as fuel and fertilizer costs continue to rise, increased savings could be realized that would offset the initial high capital investment.

Reference copy: University of Wisconsin at Green Bay Library

****

Metabolic and Cardiorespiratory Responses to Wheelchair Ambulation and Walking (Grant no. GY-11531)

Wright State University
Dayton, Ohio 45431

June 10, 1974 - September 10, 1974

Participants:

Stephen A. Barr	Mary Lynn Kiacz
Douglas J. Birnbaum	Joe Nieman
Morris Edwards	George H. Wilson*

*Student Project Director

Roger M. Glaser, Faculty Advisor

The objectives of this study were two-fold. Phase I was to compare aerobic metabolism and cardiorespiratory responses for wheelchair and walking. Phase II was to design and construct a combination wheelchair-bicycle ergometer to determine work efficiencies for these activities.

For phase I, nine able bodied male subjects (av age = 24 yrs, av wt = 86.4 kg) participated in both wheelchair and walking exercise at speeds of 3.2, 4.2 and 5.0 km/hr. Exercise at each speed was 5 min in duration followed by 15 min recovery periods. During the final 2 min of the exercise periods, and during the 5th, 10th and 15th min of the recovery periods, oxygen uptake ($\dot{V}O_2$, an indirect measurement of energy derived via aerobic metabolism), carbon dioxide output ($\dot{V}CO_2$), respiratory exchange ratio (R, $\dot{V}CO_2/\dot{V}O_2$), and minute pulmonary ventilation ($\dot{V}_E$) were determined by open circuit spirometry. For this, breathing valves were used and expired gas was collected in meteorological balloons. This gas was analyzed for volume by a dry gasometer, O_2 concentration by a paramagnetic O_2 analyzer and CO_2 concentration by infrared CO_2 analyzer. Heart rate (H R) was monitored by a cardiotachometer, utilizing chest electrodes. Mean skin ($T_{\bar{s}}$) and rectal temperatures (T_R)

were measured with an electronic thermometer using thermistor probes. Statistical analysis of data utilized paired t tests to determine any significant differences between means. Each subject, therefore, served as his own control.

It was found that VO_2 for wheelchair and walking activity were not significantly different averaging 0.842, 0.999 and 1.260 l/min STPD for 3.2, 4.2 and 5.0 km/hr, respectively. VCO_2, R, V_E, and H R were, however, significantly higher during wheelchair activity at all speeds. There were no significant differences in T_R 's or in $T_{\bar{s}}$'s for these activities, but thermoconductance (kcals/m^2/hr/°C) between the body's core and its surface was calculated to be significantly higher during wheelchair activity at 4.2 km/hr. Recovery rates for wheelchair activity were generally longer. These data indicate that, at the same speed, acute exposure to operating a wheelchair manually and walking require a similar aerobic energy expenditure, but wheelchair activity elicits greater cardiorespiratory and thermal stress than does walking.

For phase II, seven able-bodied male subjects (av age = 25 yrs, av wt = 80.4 kg) participated in both wheelchair and bicycle exercise on the ergometer. Power output levels of 50, 100 and 150 kg-m/min were employed. To determine the power output level (force X distance/time), a strain-gauge transducer in conjunction with a Wheatstone bridge circuit and a storage oscilloscope was used to measure the applied force to operate the ergometer, and a speedometer along with an electronic revolution counter (on the 167.7 cm circumference wheel) was used to set and check the distance travelled. Exercise at each power output level was 5 min in duration. Prior to exercise, and during the last 2 min of the exercise periods, $\dot{V}O_2$, $\dot{V}CO_2$, R and $\dot{V}_E$ were determined by open circuit spirometry. H R was monitored *via* radiotelemetry in conjunction with an electrocardiograph.

We found no significant differences between these physiological variables for wheelchair and bicycle activity at power outputs of 50 kg-m/min, and work efficiency was approximately 9%. At power outputs of 100 and 150 kg-m/min, however, all observed physiological variables were significantly higher for wheelchair activity. As work efficiency for bicycling rose somewhat at these higher power outputs, work efficiency for wheelchairing decreased significantly to 6%.

Data from phase I and phase II of this study indicate that acute exposure to wheelchair activity elicits great cardiorespiratory stresses. It is possible that these stresses are in response to a greater component of anaerobic metabolism, during wheelchair activity, with the resultant elevation in blood lactic acid levels. A shift toward anaerobic metabolism may be expected because of the load placed upon the small upper body musculature employed in wheelchair ambulation. In addition, unlike walking, the mechanics involved in propelling a wheelchair manually are not conducive to venous return of blood to the heart -- ultimately decreasing the O_2 supply to the working muscles.

Thermal stress may also contribute to decreased blood supply to muscles as blood is shunted to the skin for thermoregulatory purposes.

Our study has shown wheelchair activity to be relatively inefficient, as well as stressful to the cardiovascular and respiratory systems. This suggests that wheelchair activity may be hazardous to patients with cardiorespiratory insufficiencies.

Reference copy: Library of Wright State University

****

The Role of $PGF_{2\alpha}$ in Parturition in the Rat (Grant no. GY-11478)

University of Pennsylvania
Philadelphia, Pennsylvania 19104

Summer 1974

Participants:

Susan Diamond
Michael Irwin
David Greenbaum
Eric J. Seifter*
Lynn Dee Selemon

*Student Project Director

Non-Stipend Participant:

Carol Pressley

Luigi Mastroianni, Faculty Advisor

Recent evidence has shown that luteal regression is caused at least partially by prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$), which emanates from the uterus. The mechanism of this luteolytic action has not been completely elucidated, although there is evidence that $PFG_{2\alpha}$ antagonizes the actions of luteotropic hormones at the ovarian level. The functional regression of the rat corpus luteum is marked by a fall in the peripheral plasma progesterone concentration, a rise in the luteal activity of the enzyme 20α-OH-SDH, which catalyzes the reduction of progesterone to an inactive form, and a dramatic accumulation of lipids in cytoplasmic droplets. There has been no systematic study of the mechanism of this lipid build-up and no attempt to correlate this phenomenon with the other events characteristic of functional luteolysis. This project examined the patterns of lipid accumulation in the regressing rat corpus luteum of pregnancy, the temporal relationship of the lipid build-up and progesterone catabolism and the induction of lipid storage by exogenous $PGF_{2\alpha}$ in functional corpora lutea.

During gestation, the rat corpus luteum attains peak progestin secretory activity between days 14 to 16 *post coitum*. The plasma progestin concentration decreases after day 16, but falls most rapidly between days 21 and 23. Parturition usually occurs between the evening of day 22 and the morning of day 23.

Triacylglycerol levels increase over 8-fold in the rat corpus luteum between days 21 and 22 *post coitum*. Constituting less than 1.0% of the corpus luteum by weight from days 16 through 21 of gestation, the amount of triacylglycerol increases to 15.0% on day 24. There is a gradual accumulation of sterol esters between days 16 and 24 *post coitum*. This process is temporally distinct from the accumulation of triacylglycerol and the relatively small build-up of sterol esters in relation to triacylglycerol indicates that lipid accumulation during luteolysis is not primarily directed at the storage of steroid hormone precursors. The phospholipid levels decrease slightly during luteolysis, while the free sterol levels remain basically unchanged. The free fatty acid levels of luteal tissue remain fairly constant during this period, with a slight increase in levels between days 22 and 23 of gestation.

The source of the stored triacylglycerol fatty acids appears to be the plasma triacylglycerols which are elevated several days prior to parturition. Although the plasma free fatty acid concentrations do not change between days 21 and 23, there is a dramatic decrease in the plasma triacylglycerol levels that corresponds temporally to the luteal storage of triacylglycerol between days 21 and 22 of gestation. Increased triacylglycerol uptake from the blood has been related to the increased activity of lipoprotein lipase, an enzyme which hydrolyzes the triacylglycerol carried in circulating chylomicrons or very low density lipoproteins to the free fatty acid and glycerol moieties.

The following experiments strongly suggest that the accumulation of triacylglycerol during the luteolysis is directly attributable to the increased activity of luteal lipoprotein lipase. There is no increase in the *de novo* synthesis of lipids during luteolysis and a marked decline of plasma triacylglycerol levels between days 21 and 22 *post coitum*. The fatty acid composition of triacylglycerol in the corpus luteum changes to reflect an influx of plasma fatty acids between days 20 and 23 of gestation. Labelled

[^{14}C] - fatty acids accumulate in luteal triacylglycerol by day 23 in rats fed [U-^{14}C] palmitic acid in a sesame oil vehicle by gavage on days 20 through 22. There is a 4-fold increase in luteal associated lipoprotein lipase activity between days 21 and 22 of gestation.

Intact rats given exogenous PFG$_{2\alpha}$ twice-daily on days 14 and 15 show a 50% increase in sterol ester levels, a 150% increase in triacylglycerol levels, and virtually no change in the free sterol levels and in the luteal weight when sacrificed on day 16 of gestation. Hypophysectomized PGF$_2$ treated animals show similar trends for all three lipid classes. Since similar results were obtained using both intact and hypophysectomized rats, this suggests there is no pituitary hormonal control of the prostaglandin-induced accumulation of lipid. However, the observed increase of triacylglycerol under these conditions represents only about 25% of the levels observed prior to parturition. This suggests that the storage of triacylglycerol in the corpus luteum is limited by the available supply of components since plasma triacylglycerol levels are not markedly elevated on days 14 to 15 *post coitum* as they are, several days prior to term.

Based on experiments from this laboratory and from other researchers, we hypothesized that PGF$_{2\alpha}$ antagonizes the action of prolactin at the ovarian level to induce the activity of luteal lipoprotein lipase, resulting in the triacylglycerol storage observed in the corpus luteum at term. This storage of triacylglycerol does not seem to be directly related to steroidogenic function.

Reference copy: Department of Obstetrics and Gynecology, University of Pennsylvania School of Medicine

****

Tunable Laser Resonance Raman Spectroscopy of Isorhodopsin

(Grant no. GY-11538)

Cornell University
Ithaca, New York 14850

June 10, 1974 - August 30, 1974

Participants:

Carl Berke	Andrew Lo
Lawrence Charnas	Nathan Mann*
Robert Cookingham	Michael Marcus
Thomas Keffer	John Spoonhower
Robert Lewis	Mark Sulkes

*Student Project Director

Aaron Lewis, Faculty Advisor

Resonance Raman spectra of bovine rhodopsin, the primary molecule in vision, have recently been obtained, overcoming earlier problems of fluorescence (a much stronger effect which can obliterate the Raman spectrum) by eliminating accessory pigments not directly associated with the visual apparatus. In this project, these same experimental techniques were used to study isorhodopsin in order to obtain data which would elucidate the structure and environment of the center of photochemical activity in vision - the chromophore of rhodopsin. In essence, the study involved the replacement of the naturally-occuring chromophore in bovine rhodopsin (11-cis retinal) by 9-cis retinal to form isorhodopsin. A tunable laser line in the visible electronic absorption of isorhodopsin was chosen and the scattered radiation then displayed the vibrational spectrum of the chromophore responsible for the absorption enhanced over the background of surrounding vibrations.

The group also investigated appropriate model systems and the bleaching of isorhodopsin at low temperatures. Additionally, _in vitro_ examination of the Raman spectrum of rhodopsin in an intact human eye was made.

This research has shed new light on the vibrational spectrum of the chromophore responsible for vision. It is possible that, through our studies, a contribution will be made to establishing laser resonance Raman spectroscopy as a new and effective biomedical probe of the visual process.
Reference copy: Cornell University Library

****

Influences of Hormonal Levels in Females on Intellectual Attitudes and Personality (Grant no. GY-11507)

Central Washington State College
Ellensburg, Washington 98926

Summer 1974

Participants:

Margaret Bigford	Robert Flake
Vicki Braglio	Thomas Lyttle
Cynthia Fitzgerald	Gail Stevens*

Emily Stevenson

*Student Project Director

John E. Meany, Faculty Advisor

The possible relationship of sex hormone levels to different learning-achievement patterns and personality indices has yet to be confirmed. To search out this relation, we proposed to compare testosterone concentrations with selected tests of intellectual aptitude-achievement and other personality measures in college-age female subjects.

The sample comprised 63 women at Central Washington State College. The ages of the subjects at the time of testing ranged from 18 to 22 years with a mean age of 19.

Subject were carefully screened for medical history pertinent to the research plan. For example, only nulliparous subjects not receiving hormone-implicating medications or using oral contraceptives were included in the testing sample. Although the 28-day cycle is considered typical for many women, blood samples were drawn in relatively few cases on a 7, 14, 21, 28-day schedule. In order to control for the many individual departures from the 28-day cycle, minor adjustments were required for those participants who reported shorter or longer cycles, so that data obtained were consistent throughout the sample. For each subject, blood was collected as close as possible to the onset of bleeding and to the luteal phase of temperature elevation. In addition, blood was drawn during the follicular and luteal phases of the cycle.

The Washington Pre-College Test battery and the California Psychological Inventory, designed respectively to assess intellectual achievement and characteristic traits, comprised the aptitude and personality elements of the testing. Data analysis consisted of the Pearson product-moment correlation the t test.

A radioimmunoassay (RIA) technique was used for determination of subnanogram quantities of serum testosterone. According to the results, subjects' mean level of testosterone (based on four samples) ranged from 0.012 to 1.50 μg/100 ml. with an overall mean concentration of 0.059 μg/100 ml.

Variables analyzed by the Pearson correlation technique consisted of four testosterone values, 12 Washington Pre-College Test (WPCT) scale scores and the All-College Prediction score, as well as 18 scale scores of the California Psychological Inventory (CPI). In addition to these, each subject's mean level of testosterone concentration was included to represent her average "androgenicity".

It was hypothesized for this research that testosterone in females would be positively related to tested intelligence and certain dominance-related personality characteristics. According to the analysis, no correlation was observed between the All-College Prediction score, viewed as a measure of general aptitude, and androgenicity. As expected, however, the androgenicity variable negatively correlated ($r= -0.345$, $p < 0.05$) with Femininity (Fe). Further, the Self-Control (Sc) scale was negatively associated ($r= -0.286$, $p < 0.05$) with androgenicity. Low scorers on Sc tend to be seen as impulsive, self-centered, somewhat lacking in patience, and assertive. These descriptive traits approximate those suggested for low scorers on the Fe scale. Of the many possibilities, only the forementioned correlations were significant relative to the androgenicity measure.

An alternative approach was used to control subject variability based on the criterion of androgenicity. Participants were selected according to their mean measured levels of testosterone to comprise above-the-mean and below-the-mean subgroups of 20 subjects each. For the higher testosterone (T) group, mean concentration was 0.093 μg/100ml., while the mean concentration of the lower testosterone group was found to be 0.032 μg/100 ml. For each subgroup, a correlational matrix was produced containing the same variables previously mentioned.

Mean score disparities on the WPCT and CIP scales emerged between the two T groups. In terms of both positive and negative deviations, it appeared that the T groups did not differ from each other relative to intellectual achievement modes or social adjustment. Qualities such as impulsiveness, some immaturity and idealism, and relative nonconformity seemed to characterize both groups.

Of greater importance, neither subgroup's androgenicity score correlated with general aptitude, i.e., All-College Prediction. In fact, there was no difference in obtained subgroup means (high T = 51.9, low T = 51.4). From these results, greater or lesser mean concentrations of testosterone would not seem to influence tested aptitude levels, per se, but there may be suggestions of paraintellectual dispositions which favor differential responses to social and intellectual demands.

The high T group surpassed the low T group with respect to Dominance (Do) and Capacity for Status (Cs), but scored slightly lower on most other scales, including Femininity. However, since the androgenicity variable was not significant relative to either Do or Cs for the high T group, the relationship is of dubious value. Moreover, the difference in sample means is viewed with reservation since the t value for Do and Cs failed to significantly distinguish the two subgroups.

As expected, the high T group's Femininity mean scale score indicated "masculine" characteristics more compatible with the stereotypic view of gender traits. Indeed the t-ratio calculated between sample means indicated a significant difference (p 0.05) on the criterion of Femininity. According to the trait description associated with this measure, the high T group might be viewed as moderately outgoing, striving, active, restless, and direct in thinking and action. On the other hand, the low T group's trait cluster suggested that they tended to be more patient, appreciative, perservering, conscientious, and sincere.

Interestingly, the obtained t value ($p < 0.20$) for Spatial Ability (WPCT), although not of large magnitude, may suggest that among females, higher androgen levels exercise a positive influence on spatial skills. Researchers have suggested that spatial ability, or field independence, develops under the influence of sex hormones.

Reference copy: Victor J. Bouillon Library, Central Washington State College

* * *

Computer-based Communications Utilities (Grant no. GY-11417)

University of Illinois
Urbana, Illinois 61801

May 20, 1974 - August 9, 1974

Participants:

John Bailey
James Bowery
Robert Bretzlaff
Mary Jane Buy
George Carter*
Nancy DeYoung
James Gilfillan
Sandra Leach
Gary Madelung
Vicki McMahon
Ivan Pour
Richard Roloff

*Student Project Director

Heinz Von Foerster, Faculty Advisor

Broadly conceived, this project was concerned with the emergence of a new medium of group communication, which has come to be known as "computer-based communications". The distinguishing characteristic of this new medium is its ability to enhance communication, most importantly among groups of geographically-dispersed individuals, through employing the tools made available by modern computer technology. A computer-based communications can provide a communications system potentially able to adapt to the skill of the user, interactive graphics, asynchronous communication, service functions (including information retrieval and simulations) and the optimum use of available bandwidth. These system features can dramatically increase the problem solving potential of telecommunications.

The project was specifically concerned with one of the more widely discussed applications of computer-based communications--computer conferencing. This is a form of group telecommunications which enables geographically-dispersed groups to exchange the same types of information over a teleconferencing system (at a distance) that they would face-to-face (in the same room). One commonly mentioned application of this technique is the supplementation of the professional communication that occurs at traditional scientific meetings by ongoing computer conferences. Other applications include:

A. Research problem consultation;

B. Refereeing of professional papers;

C. Evaluation of proposed graduate research;

D. Coordination of large, geographically dispersed group efforts such as responses to natural disasters (forest fires, earthquakes and various severe weather crises);

E. National networks of citizen and professional groups desiring to coordinate activities.

The project was directed at the following three aspects of computer conferencing:

A. System Development;

B. Human Factors;

C. Experimental Networks.

Most of the effort during the stipend period was focused on system development. Using the PLATO computer-based education system as a base, the computer software (application programs) was developed for an advanced conferencing system. The human factors aspect of our work consisted primarily of literature searches to determine the applicability of related engineering psychology studies on the design of the conferencing system. The experimental networks aspects refer to actual use of the programs developed and the preliminary studies of potentially large-scale implementations. Each of these aspects is explained in greater detail in the remainder of this abstract.

The principal goal of the conferencing system development was to contribute to the current state-of-the-art by organizing a system that allowed the user to make extensive use of computer graphics. This goal was achieved. While other existing conferencing systems restrict the user to the entry of alphanumeric information to the "conference proceedings," our system provides the ability to enter and retrieve graphic information as well. A conference participant may supplement his textual contribution with a line drawing or illustrate experimental results with a graph. Both textual and graphic information may exist on the same frame.

The use of graphic displays in the proceedings of a computer-based conference is analogous to the use of figures in a scientific journal. Although we found these display graphics to be most useful, it soon became clear that the computer technology employed could also support more sophisticated interactive graphics techniques. Most significant in this area was our implementation of self- and cross-interaction matrices as new methods of quickly narrowing the scope and focus of computer conferences.

The human factors aspect of computer conferencing systems raises new questions that have not been adequately dealt with on a theoretical basis in either computer science or engineering psychology. Indeed, the entire human-computer interaction area has just recently attracted attention in both fields. Because of the lack of existing theoretical groundwork, our contributions in this area consisted primarily of a review of the man-machine systems literature to determine which existing studies have dealt with problems analagous to our own. Such reviews are an essential prerequisite to formal experimental investigation.

We examined the similarity of the "fidelity of simulation" question facing both teleconferencing and synthetic training investigators. It notes that regardless of whether one is trying to simulate an aircraft through the use of an aircraft simulator on the ground or simulate a group (face-to-face) meeting through the use of a teleconferencing system, the central human factors problem remains the same. That problem is to determine the essential cues that need to be transmitted by the intervening technology in order for it to be effective. Since the major cost of these systems is fidelity - dependent, unneeded fidelity (non-essential cues) adds significantly to the cost. The motivation for making this analogy is the potential of three decades of synthetic training research making a useful contribution to the recent interest of teleconferencing systems.

The final aspect of study concerned experimental networks. This had two foci. The first was the actual use of simple versions of the conferencing system we were developing. During the last two years we have conducted over thirty computer-based discussions in order to gain actual experience in the use of this new medium. Below are listed some selected topics that were discussed:

A. The Future of Champaign-Urbana;

B. Computer-based Communications Media;

C. The Future of the University;

D. The Energy Crisis;

E. Women in Society -- General Overview.

The second focus was a far more ambitious one. We became convinced that the techniques of computer-based communications can be extended beyond its use as an experimental communications medium. The transition to a true communications utility is foreseen. In order for this transition to occur, a demonstration needs to be made that these techniques are able to provide superior cost-effective solutions to well-recognized problems. We have collected preliminary data on the use of computer-based communications to assist in the suppression of large forest fires and to assist in the flight planning process.

Reference copy: University of Illinois Library

****

High Intensity Noise, Social Behavior, Preferences and Cortisol Levels in Rhesus Monkey (Grant no. GY-11519)

University of Wisconsin at Madison
Madison, Wisconsin 53706

May 20, 1974 - August 10, 1974

Participants:

John L. Cotton
Melanie M. Ignjatovic
Charles J. Juno
Misao E. Kusuda
Mark E. Larson

John A. Mikesell*
Michelle Peters
Stanley W. Urban, Jr.
Lawrence S. Wasserman
Hannah Ming Hsien Wu

*Student Project Director

Charles T. Snowden, Faculty Advisor

The present study investigated the effects of exposure to high intensity noise on blood plasma cortisol levels, object preference and social behavior in one and three-year old rhesus monkeys. The noise was presented under three degrees of perceived influence:

1. Perceived influence
2. Perceived loss of influence
3. Perceived no influence

In addition, a no noise group was established to serve as a control condition.

The experimental paradigm involved 24 rhesus monkeys. Each age group of 12 Ss was sub-divided into 3 groups; control, perceived influence, and perceived no influence. The same Ss tested in the perceived influence condition also served as Ss for the perceived loss of influence condition.

It was hypothesized that younger Ss would exhibit a greater amount of stress than older Ss. For both age groups, the highest amount of stress was predicted for Ss in the perceived loss of influence condition with control Ss and perceived influence Ss exhibiting the lowest amount of stress. The stress levels of the perceived no influence Ss were expected to be between the stress levels of the other conditions.

No significant age interactions were found; however, the physiological dependent measure of cortisol totally substantiated the other hypotheses proposed by this study. Findings from the behavioral dependent measures partially substantiate these hypotheses but they were found to be vague and less reliable.

Reference copy: Library, University of Wisconsin at Madison

****

Behavioral and Physiological Consequences of Sub-Lethal Dosage of Methylmercuric Chloride (Grant no. GY-11482)

California State University at San Francisco
Daly City, California 94015

June 1, 1974 - August 31, 1974

Participants:

Enrique C. Becali*	Vena Benger Moudgil
Thomas E. Carney	Mary E. Salmon
Cynthia M. Degnan	Carol D. Williams
Wilma Johnson Frank	James J. Wong

*Student Project Director

John S. Williston, Faculty Advisor

The purpose of this study was to assess the behavioral and/or physiological abnormalities in rats transplacentally exposed to variable dosages of methylmercuric chloride. Single doses (1 mg/kg, 9 mg/kg) of methylmercuric chloride were given to 22 female Srague Dawley strain rats on the 16th day of pregnancy. At birth, some pups were immediately sacrificed and examined by means of autoradiographical and histological techniques. Others were sacrificed at 14 and 30 days of age and examined by similar means. Developmental measures (weight, eye opening, startle response) were recorded; observations of maternal behavior (nesting, rearing, and pup collecting) were made. Studies were made of fecal and urinary excretions of pups housed in metabolic cages. Behavior was recorded on response trials (38 - 40 days) to open fields and swimming response and active and passive avoidance conditioning (41 - 50 days). Electro-physiological surveys (47 - 55 days) were performed with auditory and visually-evoked responses. Final histological examinations were made on a random selection of the remaining animals.

This investigation provides new information on the behavioral and neurological effects of moderate and light exposures to a form of mercury which may pose a substantial threat to the environment.

Reference copy: Library, California State University at San Francisco

****

Specificity of a Sound Habituation Peptide: Biological and Chemical Assays (Grant no. GY-11418)

Rice University
Houston, Texas 77001

May 13, 1974 - August 4, 1974

Participants:

Neely Atkinson	Patricia McGovern
Larry Dismuke	Debra W. Osterman*
Ralph King	Sally Stabler

Rodney Taylor

*Student Project Director

Raymon M. Glantz, Faculty Advisor

One of the major controversies in molecular neurobiology centers on the question of the behavioral specificity involved in production of "memory transfer" effects. This project undertook an evaluation of ameletin, a peptide recently isolated by Ungar and Burzynski which produces sound habituation when injected into mice.

The study first developed an objective means of recording the habituation phenomenon in mice and rats.

As in all memory transfer experiments, many relevant variables remain to be specified with regards to the sound habituation phenomenon. One of these previously unspecified variables became apparent as a result of this project. Whereas Ungar and Burzynski's rats normally took from 10 to 14 days to reach criterion, the rats habituated at Rice took an average of 30 days. Furthermore, when extracts prepared according to the method developed by Burzynski were tested by Ungar's technician, results were non-significant. Later, when rats were habituated at Baylor, a probable explantion for this variation presented itself. The rats behaved differently during habituation as a result of differences in housing. The Rice rats were housed in opaque white polypropylene cages, 20" x 16" x 8½", with San-i-cel litter and six to 10 rats per cage. During habituation, they were quite active for the first half hour, then settled down. At Baylor the rats were housed in 12" x 8" x 8" metal cages with wire bottoms, three rats to a cage. These donors were inactive throughout the entire habituation session.

The majority of the project's efforts have been concentrated on the development of a more objective testing measure. By trial and error, a potentially useful method has been developed. A mouse's responses to the bell are recorded on paper throughout the use of a resistor-capacitor circuit. The mouse is placed in a restrainer to minimize random movement. An aluminum-foil capacitor with a dielectric of rice paper rests on the floor of the restrainer beneath the mouse. As the mouse startles, the distance between the capacitor plates changes. This changes the capacitance and, since the voltage is fixed, the charge on the capacitor plates must change. This change in charge manifests itself as a current measured across the resistor. The Physiograph tracings offer a permanent record of each experimental session. In some cases, it was possible to pick up clear responses against a background of either heartbeat or respiratory movements. As the mouse becomes habituated to the bell, more non-responses are observed and a greater number of random movements may intrude upon the record. This method allows the experimental data to be evaluated at leisure and does not require the snap judgements of the original testing method.

Tests of the synthetic peptide are being made. To evaluate the specificity, pure tones of set frequencies are used for testing, in addition to the usual complex bell tone. Furthermore, a recent breakthrough may allow us to obtain a dansyl spot for ameletin, thus offering a chemical assay for the specificity of training conditions.

Reference copy: Library, Rice University

****

Effects of Urban Pollutants on Growth of Human Cell Culture

(Grant no. GY-11506)

Seton Hall University
South Orange, New Jersey 07079

May 1974 - September 1974

Participants:

Rytis Balciunas
Nesrine Baturay
Lois Buonincontri
Richard Deininger
Nestor Holyk
Ben Novograd
Barbara Parson
Leon Pirak*
Robert Sheridan

*Student Project Director

Ernest V. Orsi, Faculty Advisor

Increased air pollution levels have been implicated in increased pathology of the respiratory system. Reports in the literature and research in the biology department at Seton Hall University have shown a response of cell cultures to air pollution.

A systematic study of the chemical and meteorological properties in higher and lower air pollution regions and the characteristics of cells cultured in these areas would provide a model system for the response of cells to air pollution.

In previous studies, HEP-2 (human pharyngal tumor origin), as well as BS-C-1 (African green normal monkey kidney origin) have been used to monitor the response of established cell cultures to environments of varying air pollution levels. In these experiments it was found that these established cell lines, cultured in areas of high air pollution proliferated at a faster rate than those in lower air pollution.

The summer work incorporated the the use of a non-established, normal cell line, HEL-299. It is important to note the origin of this cell line in that it was obtained from a Negroid foetal lung after only four passages. This cell line also has a predominance of cell characteristics similar to that of the tissue of origin.

The study of HEL-299 was conducted at four installations: Beaver Wil Farm (average particle count, 15,000 nuclei/cm.^{3}), Wilmington; New York, Atmospheric Science Research Center (ASRC) of the SUNY-Albany (average particle count, 7,200 nuclei/cm.^{3}), Wilmington, New York; New Jersey College of Medicine and Denstry (average particle count, 72,800 nuclei/cm.^{3}), Newark, New Jersey and Seton Hall University (average particle count, 49,000 nuclei/cm.^{3}), South Orange, New Jersey. The Wilmington installations served as the low pollution models, while the two New Jersey stations were considered the sites of high air pollution.

The study included not only the synchronous passages of the cells at the four installations, but the simultaneous monitoring of inorganic gaseous pollutants, as well as meteorological conditions. The gaseous pollutants under study were SO_2, O_3, and other oxidants. Atmospheric variables measured included condensation nuclei, wind speed and direction, and frontal activity that would account for precipitation and pollution levels.

The HEL-299 was cultured in two different types of media; L-15 (Leibovits) medium was used for the system exposed to ambient air (open culture vessels with sterile plugs), while MEM (Eagle's) was used in the conventional closed system. It is important to note that all handling, traveling, and renewing of both cell systems was carried out synchronously.

The rate of proliferation was measured by standard trypan blue exclusion hemocytometer cell counts, while visual inspection monitored the morphological conditions of the cell cultures. In two previous experiments conducted by students at Seton Hall University using HEP-2 and BS-C-1, it was found that the ratio of the number of open culture cells to the number of closed culture cells was always larger in areas with high pollution levels than the value determined for low pollution areas. These findings indicate that the established cell lines have a faster rate of replication in the highly polluted area. However, using the HEL-299 cell line the trend of O/C values was opposite to that of the established HEP-2 and BS-C-1 cell lines.

The research emphasis was to repeat the previous findings, by other students, using the established cell line, HEP-2, and attempting to duplicate the HEL-299 0/C trend. The HEP-2 0/C trend agreed with the work of previous Seton Hall University students, implying that this tumor line was not deleteriously affected by a highly polluted environment. A rigorous procedure was devised for further HEL-299 experiments and it was found that the previously described HEL-299 0/C trend was verified. Another corroborating finding was the greater frequency of abnormal morphology associated with the HEL-299 cells cultured in the high pollution areas.

The chemical evaluation of the ambient air was conducted simultaneously and in close proximity to the cell cultures. The SO_2 concentration was determined using the established West-Gaeke colorimetric method, while ozone and oxidant levels were determined by using the "buffered alkaline" colorimetric method. In both cases, the ambient air was drawn through impingers containing the characteristic absorbing reagent for that particular pollutant. Since the volume of bubbled air, as well as the volume of absorbing reagent are known quantities, a simple calculation yielded the concentration of pollutant.

It was not surprising to find that sulfur dioxide and oxidant levels were higher in the New Jersey environments. The relative difference between the Wilmington and the New Jersey installations represented a 20-fold increase in SO_2 levels and a 10% increase in oxidant concentration.

An interesting point is that the pollution level at the Seton Hall installation was consistently 10 to 20% higher than that of the College of Medicine and Dentristry site. Since Newark is an industrial city, while South Orange is a suburban locale, one would not expect this finding. However, one could explain this result on the basis of an almost exclusive westerly wind which blows directly over Newark toward South Orange, five miles away.

Several different methods were used in determining relationships between various air pollution components and weather patterns over a given station. Small particle counts are related to wind direction, wind speed, presence or absence of precipitation and air mass origin (determined by paths of surface air traced back from Wilmington or Neward using wind direction and speeds shown on surface maps). Ozone amounts are correlated with surface positions of fronts, atmospheric subsidence, air mass origin, and wind direction; sulfur dioxide, carbon monoxide, and carbon dioxide are related to wind direction, wind speed, air mass origin, and precipitation patterns.

Reference copy: Seton Hall University Library

****

The Effects of Pre-Pubertal Methadone Administration on the Sexual Development and Maturation of the Laboratory Rat

(Grant no. GY-11484)

Antioch College
Yellow Springs, Ohio 45387

July 1, 1974 - December 20, 1974

Participants:

Michelle Gerhard
Neil Goldstein
Jay Heinecke
Sam Kent
John Mendelson*
Mike Pendelton
Chris Plescia
David Poutasse
Jean Smith

*Student Project Director

James C. Howell, Faculty Advisor

Recent experimental data have indicated that plasma testosterone levels can be suppressed by a variety of chemical agents, including heroin, morphine, methadone, and ethanol. It has also been well established that testosterone, during fetal as well as adult life, is essential for proper male psycho- and physio-sexual development and function. This study investigated the effects of both pre- and post-natal methadone administration on sexual development and maturation in the rodent.

Sprague-Dawley laboratory rats, maintained under standard laboratory conditions, were addicted to 5 mg/kg/day of methadone HCl (Lilly). Animals were administered methadone _via_ daily subcutaneous injections of the drug dissolved in saline.

Experimental animals were addicted during critical sexual development periods: during the first third of gestation; from the 18th day of intrauterine life to the 10th day post-natally; and at day 50 post natal (i.e., puberty). Accordingly, one group was administered methadone chronically from conception to the conclusion of the experiment; another from the day of birth to 10 days post natal; a third from days 10 to 40 of life; and a fourth from day 40 until the conclusion of the experiment.

The following control groups were also established: sham-addicted, which followed the same treatment schedule as the chronics, male castrates, and normals.

At approximately 65 days of age both male and female animals were observed for sexual behavior with a receptive partner and under standardized conditions. The following behaviors for male animals were obtained -- mounts, intromissions (vaginal insertions), ejaculation latency and mount frequency. Lordosis quotients (number of lordosis per mount) were computed for females.

Following behavior testing, animals were sacrificed, the blood collected and analyzed for testosterone, FSH and LH. The liver, kidney, gonads, adrenals and pituitary were dissected out and weighed.

Analysis of the behavioral section of the experiment indicates that for animals which do exhibit sexual behavior no changes were observable between any groups (with the obvious exception of the castrates), but there was a significant suppression of the ability to display specific behavior in the chronically-treated group. In other words, if they perform, they perform normally. If they lack a behavior, they lack it completely.

Reference copy: Olive Kettering Library, Antioch College

****

Section II.

Natural Resources Studies

Papers from Columbus College, University of California at Berkeley (2), San Jose State University, University of Kansas, College of the Atlantic, University of Oregon, SUNY - State University at Albany, Louisiana Tech University, St. Olaf College, Harvard University, Evergreen State College, Illinois Institute of Technology, Marquette University, Weber State College, Eastern Oregon State College, University of Montana, Heidelberg College, University of Texas at Austin, University of South Carolina, Oregon State University, Miami University, Sam Houston State University, University of Northern Colorado, New Mexico Institute of Mining and Technology, Brigham Young University, University of California at Irvine, Bellarmine College, and California State College at Stanislaus.

Environmental Inventory and Assessment for the John Rigdon Center (Grant no. GY-11498)

Columbus College
Columbus, Georgia 31907

June 10, 1974 - August 30, 1974

Participants:

Joanne R. Blum
Deborah L. Braun*
Eugenia R. Cowan
Norman D. Dennis
Michael P. Hardy
Raymond R. King
Barbara L. Meyer
Robert M. Poole
Kenneth S. Saladin
Stephen F. Shaefer
Robert E. Thompson
George H. Verner

*Student Project Director

Non-Stipend Participants:

Joel D. Elrod
William D. Le Noir
Earnest C. Smith

George E. Stanton, Faculty Advisor

Most of the city of Columbus, Georgia is built upon the Bull Creek watershed area. The community drainage system, under the leadership of late county commissioner and councilman, Mr. John Rigdon, has been developed for recreation and flood control. In the northwest section of Columbus there is a 400-acre parcel of land, a part of which has been designated as the John Rigdon Environmental Education Center. The parcel consists of former farmland, pastureland, and woodlands, and was obtained by the city and county some years ago. Two hundred fifty acres of this parcel have been developed as a municipal golf course; the remaining portion has remained undeveloped and has been set aside as a site for campgrounds and for the environmental education center.

During the summer of 1974, we made an assessment of the environmental resources of the proposed John Rigdon Center. Two major aspects of our survey were an analysis of three water impoundments and a terrestrial inventory of the study site, with emphasis on flora and arthropod fauna.

Limnological analysis included studies of the physical, chemical, bacteriological, planktonic, benthic, littoral, and nectonic components of the three impoundments of the area. Standard methods were used employing a Y.S.I. dissolved oxygen meter, Hach direct reading field laboratory, millipore filter apparatus, plankton net, Ekman dredge, nets, and seines. Specific information was collected on temperature and oxygen stratification, pH, nutrients, morphology of the impoundments, pollutant bacteria, distribution and stratification of plankton, and fish productivity.

All three impoundments showed thermal stratification with an epilimnion, hypolimnion, and metalimnion. Typically, there was an oxygen deficit in the hypolimnion below approximately five feet. Due to low oxygen conditions, the benthic communities of all three impoundments were low in diversity. The two deeper impoundments were generally low in nitrates and phosphates, and the availability of these nutrients was probably the limiting factor in both systems. Fecal coliforms were found in all three impoundments; however, they were significantly higher in the smallest (Macon Impoundment: 1.5 acres), because of livestock watering. Abundant plankton was collected from the three impoundments and rotifers were found to be especially abundant and diverse.

The largest impoundment (Bull Creek Impoundment: 48 acres) was estimated to be reasonably well balanced; however, it seems to be tending toward an overabundance of forage fish. In addition to Lepomis (blue gill) and Micropterus (bass), this impoundment has been invaded by Pomoxis (crappie) and Ameruirus (catfish), these species presumably having come down stream from Bull Creek. The presence of crappie is responsible for overcrowding of forage fish and, unless corrected, this will probably get worse.

Psalmond Impoundment (5.4 acres) although currently balanced, is progressing towards a condition of heavy predation on forage fish; and Macon Impoundment shows an overcrowding of carnivorous fishes.

If fishing is an ultimate goal, Psalmond and Macon Impoundments suffer from inadequate fishing pressure and Psalmond and Bull Creek Impoundments suffer from inadequate fertilization necessary for bass fishing in a Southern impoundment.

To study the vegetative communities, a quarter method was employed in wooded areas and a quadrat method was used in old field areas. In this way we identified types and parameters of plant communities present, determined frequency, density, dominance, and importance for trees and saplings in forest areas, as well as the approximate successional stage and dominant vegetation of old field communities. In order to determine and inventory vegetative diversity, extensive collecting was carried out from June through August. Plants collected were identified and preserved as herbarium specimens and are housed in the Columbus College herbarium. A total of 256 different vascular species were collected, identified, and mounted. This represents a major portion of the native summer flora. However, this is not a complete collection of all vascular plants native to this area because many species were not in fruit or flower and, thus, could not be identified. The wooded areas were found to be in varying stages of advanced succession approaching climax communities of an oak-hickory association or a pine-sweetgum association. Old field communities were in various stages of primary or secondary succession ranging in age from one to 25 years. All successional patterns were illustrative of those found in Georgia piedmont.

Terrestrial fauna sampling was largely a qualitative inventory of arthropod types. Samples were taken using nets, habitat searching, night light collecting, and soil sample extraction. Prior to identification, all specimens were prepared by pinning or preservation in vials. Upon identification they were stored in Academy drawers, and housed in the Columbus College zoology laboratory. A total of 2432 insect specimens, representing 11 orders, was collected. From forest communities came 1021 (46%), and from field communities came 1411 (54%). The orders encountered were members of orders one would usually expect to be abundant on an aerial vegetation in terrestrial biomes. These terrestrial biomes, rather than possessing some inherent stability that resists outside modifications, are probably quite vulnerable to losing diversity and homogeneity along with stability, if too much interference is visited upon them. With this in mind, we would recommend a cautious approach to any extensive modification of the forested areas.

Two concurrent studies were carried out. The first of these was an examination of the distribution, succession, and community association of carrion-utilizing arthropods. Rat carcasses were placed and periodically sampled in a number of the recognized plant communities. The second study was an analysis of invertebrates attracted to ammonia-producing bait traps suspended at different elevations in various plant communities.

It is our hope that this inventory and assessment has provided useful information and documentation that can assist the city government in planning and utilizing the environmental center. The study has provided us with data which were used in making suggestions for suitable locations of proposed structures and for desirable maintenance projects. In addition to recreational interests, our report and suggestions will, hopefully, provide ideas which can be further pursued by the educational community.

Reference copy: Columbus College Library

****

A Study of the Fire Ecosystem as it Relates to Vegetation, Soil, Water, Mammal Populations, and Evolutionary Adaptations of the Forest (Grant no. GY-11497)

University of California at Berkeley
Berkeley, California 94720

June 15, 1974 - September 15, 1974

Participants:

William Beckett	Michael Groth
Russel Greenberg	Phillip Omi
John Greenlee	James Villeponteaux*

*Student Project Director

Non-Stipend Participant:

Elizabeth Sheekey

Arnold M. Schultz, Faculty Advisor

Since 1968, the Sequoia and Kings Canyon National Parks have pursued a new policy with respect to lightning fires. Prior to 1968, all detected fires were immediately attacked by suppression forces with the objective of minimizing acreages burned. Since 1968, fires originating from natural causes in selected areas of the Parks have been allowed to burn under the close surveillance of Park fire experts. The selected areas constitute the Natural Fire Management Zone (NFMZ). Generally, lands within the NFMZ are high in elevation and the fires present no threat to structures, to lands protected by other agencies, or to other high value resources. At present over 70% of the land area within the two Parks is included in the NFMZ.

The rationale behind the Let Burn Policy can be traced to the founding principles of the National Park Service. The purpose of the National Parks is to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations". The Policy was given additional impetus as a result of the Leopold Report (1963), which recommended that the National Parks should be a showplace of the forest conditions prior to the coming of European man. Park officials had previously determined that the policy of complete fire suppression had resulted in a vegetative mosaic quite unlike that observed by primeval man. In many places, dangerous fuel accumulations presented a threat of impending wildfire devastation. In the past, such accumulations were subject to periodic reduction by natural fires. Thus, the Park Service reformulated its fire management policy (see USDI, Administrative Policies for Natural Areas of the National Park System) to allow naturally-ignited fires in the high elevations "when such burning will contribute to the accomplishment of approved vegetation and/or wildlife management objectives". The Policy also allows that "prescribed burning to achieve approved vegetation and/or wildlife management objectives may be employed as a substitute for natural fire".

The overall objectives of this study were:

I) to evaluate the Let Burn Policy's fulfillment of the National Park Service's goals, by
  A) examining the community dynamics of the area, with and without fire, using:
    1) evidence from stand-age analysis, and
    2) other feasible methods such as stability and community diversity.

II) the economic impact of the Let Burn Policy, as compared to fire suppression.

We intended to approximate the natural state by determining the area's pre-European man condition. We wanted to determine the post-burn state of the area and to hypothesize what will happen successionally, with and without a continuous fire input.

Our study focused primarily on the Sugarloaf Valley in Kings Canyon National Park. In the summer of 1973, the South Sentinel Fire occurred which burned approximately 2,500 acres on the north side of Sugarloaf Creek. We conducted a preliminary vegetation survey in July of 1974, from which we delineated three habitats, on the basis of species composition and intensity of ground cover. These habitats are:

1) Open - consisting of Jeffrey Pine (Pinus jeffreyi) and Lodgepole Pine (Pinus contorta muricata);
2) Closed - consisting mainly of White Fir (Abies concolor), with some Jeffrey Pine and Lodgepole Pine present;
3) Brush - consisting mainly of Manzanita (Arctostaphylus patula), with some White Fir, Jeffrey Pine, and Lodgepole Pine.

Following is a summary of the findings of our study:

Allowing naturally-ignited fires to burn has resulted in net savings to the fire management budget in Sugarloaf Valley.

No significant differences could be shown in the water quality factors examined between burned and unburned watersheds.

Fire had differential effects on the three habitats studied. The open habitat exhibited the least change in overall vegetation responses to fire. Moderate changes were observed in the closed habitat. The brush habitat showed the greatest responses. Ground fuels in the brush habitat respond most rapidly to weather changes. These fuels have the highest burning potential during dry conditions. In general, Lodgepole Pine had a higher survival rate than Jeffrey Pine, while White Fir exhibited the lowest survival rate of the tree species studied.

Animal response to fire was often immediate, with birds, deer, and squirrels observed feeding over areas burned the same day. Some aerial insectivores, such as swallows and swifts seemed to be attracted to smoke. Even so, fire will mainly affect the wildlife carrying capacity by habitat alterations. The differences in bird and small mammal populations was most dramatic between burned and unburned brush habitats. In general, the burned areas in brush supported major invasions by seed-eating birds. Midsummer deer mouse populations were higher on the burned brush portions of the Valley.

The burned and unburned portions of the Valley differed in the heterogeneity, composition, and diversity of vegetative communities. These measures generally were higher on the burned habitats.

During our study, another fire burned the previously unburned portions of Sugarloaf Valley (the Comanche Fire). Our unburned study sites are now burned. This will allow us to return next year to obtain more information on fire's behavior in the wilderness ecosystem.

Reference copy: Forestry Library, University of California at Berkeley

****

An Ecological Study of a Sub-Alpine Cirque Basin (Grant no. GY-11412)

San Jose State University
San Jose, California 95192

June 9, 1974 - August 31, 1974

Participants:

Adams Bushnell
Robert Charles*
Bonnie Green
Terry Hart
James La From
Victor Maggi

Rebecca Marchello
Ronald Mortenson
Edward Piccolo
Lynn Tweedie
Jeanne Vollenweider
Kathleen Williams

*Student Project Director

Richard Carey, Faculty Advisor

Lake Schmidell, El Dorado National Forest, California is located about eight miles from several major trail heads which lead into the Desolation Wilderness Area. The lake is located on the western side of the Sierra Nevada divide, and is surrounded by a cirque basin approximately 2.5 miles long and one mile wide.

The purpose of the study was to describe values to the public scientifically, aesthetically, and economically by: 1) providing needed scientific data; 2) preparing a curriculum-oriented guide for use by school systems in Calfornia;

3) formulating an informative, illustrated, educational booklet for use by laymen; and 4) establishing a data baseline for use in future comparative studies.

A school-oriented curriculum guide was compiled which stresses the study of environmental problems; specifically, how the scientific method and hypothesis solving can be used by the student. Student-teacher interaction is encouraged using the teacher as an information source. An extensive bibliography was included and the presentation of the students' papers was emphasized.

A laymen's guide was written as a collection of articles with the intent of covering different aspects of nature study, indicating methods and equipment and some descriptions of commonly seen plants and animals.

The geologist compiled a geologic map showing the structures and boundaries of various kinds of plutonic and metamorphic rocks. Cirques, moraines and striations were located and mapped; of particular interest was a shearing zone and some areas of cross-bedding. Soil compaction sampling showed that soil far away from the trails was less compacted than the soil next to the trails. Soil composition analyses yielded no clear correlations between bedrock, soil, and plant communities. X-ray patterns of clay sized fractions of the soil indicated that there were essentially no clays.

More than 23 families, 46 genera, and 60 species are listed, representing the flora of the Lake Schmidell study area. The botanist differentiated the study area into four major vegetation types: Willow, Meadow, Coniferous, and Rock

Habitat. These types were divided into several specific communities or habitats. Charts were made to ten plots, and tables provided information as to the distribution of the trees and shrubs by section, the relative dominance with the plots, the density within the plots, and the distribution of the herbaceous plants by section.

Physical, chemical and biological studies were conducted on Lake Schmidell and its associated waters. The lake was found to be alpine oligotropic in nature, characterized by low nutrient levels, high oxygen content, and low summer water temperatures. The lake was surveyed and charts were made illustrating the thermal stratification and oxygen variation throughout the summer. Stomach analysis performed on the Eastern Brook trout caught in gill nets indicated that the fish fed primarily upon larval and adult forms of the Family Tendipedidae (ghost midges). Size measurements and visual inspection of the fish indicated that the fish were somewhat stunted.

Six species of herptiles were found at Lake Schmidell out of a possible 16 species suspected of being in the area. The six species were associated with water. The cause of so few species being sighted was probably the geologic barrier to migration created by the high rocky ridges surrounding the study area.

Meteorological data were gathered twice daily throughout the summer. Temperature, wind direction and strength, and relative humidity were recorded as well as rainfall.

The mammalogist ran trap lines at night and during the day. The Golden Mantled ground squirrel was the most frequently noted mammal in the area. Martens were sighted frequently and even ran though our camp during the day on one occasion.

Over 1,470 insects were collected and over 1,300 were identified to family level. Fifteen out of 27 known orders were represented, and 117 families were found in the study area. The entomologists have included their field notes in the final report which emphasize the methods of capture, natural history, and the ecological relationships of the collected insects.

Waters in the study area were tested for organisms (fecal coliforms, fecal streptococci and total coliform) that may indicate the presence of pathogens harmful to man. The tests indicated there was not a significant level of fecal pollution in the waters to warrant concern over drinking untreated water. Many water sources in the area should be avoided because of their close proximity to livestock or because of the high total coliform counts which probably occurred from contamination of the water by soil bacteria.

Mammal and bird scats were collected during the summer. So little data were obtained over the short summer that conclusions were difficult to draw. Small mustelid predators were concentrated in areas populated by humans probably because of the high population of ground squirrels and the garbage left by campers (which provided an easy food source).

A total of 57 species of birds was observed in the study area. The habitat, population, food, and nesting sites of these birds were examined. There were about 186 breeding pairs per 100 acres, and 63% of all species ate insects, 25% ate plant material, and 12% ate ground animals. Thirty-five species of birds were on their nesting grounds and in their breeding season.

The sociologist observed people who came into the study area, and recorded where they camped, their camp habits, and their general appearances. The average hiker was between the ages of 20 and 30, male, and with one or two friends. Most of the trails were found littered with candy wrappers throughout the summer, and many hikers left burnable trash in the fire pits to be burned by other campers. Privacy seemed to be of little concern when choosing a campsite, the main consideration being nearness to water.

Reference copy: San Jose State University Library and the Impact Library of the Biological Science Department, San Jose State University

****

Interdisciplinary Approach to the Potential Biological Control of Cockroaches (Grant no. GY-11465)

University of Kansas
Lawrence, Kansas 66044

May 15, 1974 - August 15, 1974

Participants:

Michael D. Breed	Caprice Hinkle
Theodore E. Burk	M. Lynn McAnelly
Blaine J. Cole	Margo K. Roberts

Jeffrey A. Cox
Shelley P. Gallup
Richard Gay
James B. Grimes
Michael K. Rust
Gary R. Sams*
Chung Shih
Patrick A. Sillix
Patricia G. Wetherell
*Student Project Director
William J. Bell, Faculty Advisor

In recent years the inadequacy of insecticides in coping with pest insect species has become obvious. This inadequacy is basically due to the development of resistant strains of insect species, the accumulation of insecticide residues in the environment and the effects of insecticides on organisms other than pest species. Thus, it has become imperative that alternatives to insecticides be investigated. Two potential alternatives for control are insect pheromones and hormones. These agents function as chemical communicators integrating insect development and reproduction; consequently, they offer the capability of disrupting normal biological functions. In addition, these agents may offer safer control techniques, since they are naturally-occurring compounds and have the potential to be species specific.

This study was initiated to determine the potential for these techniques in controlling cockroaches. Investigations included determinations of the effects of hormone analogues on morphogenesis and development of the cockroach, Periplaneta americana, elucidation of the behavior which is elicited by cockroach pheromones, and investigations into the ecology of natural populations of cockroaches. An attempt was made to isolate chemically and to identify the Periplaneta americana sex pheromone.

The chemistry group developed a chemical isolation procedure for the sex pheromone, utilizing triple column chromatography. This process provides a purified, active sex pheronome fraction. This fraction was then gas chromatographed, separating the fraction into different retention peaks. The resulting ten compounds were tested for sex pheromone, using a behavioral bioassay; only one fraction elicited courting behavior in male cockroaches. At the present time, sex pheromone is being collected in order to obtain enough material to elucidate the structure of the compound using spectroscopic techniques.

The physiology group determined that the concentration of juvenile hormone (which acts in physiological processes of development) in vitro is very critical and that high concentrations of JH will elicit non-physiological responses. Thus, it is possible to increase the levels of JH in the organism and to obtain abnormal development. We were able to accomplish this by applying several juvenile hormone analogues produced by Zoecon Corporation, using spray applications. Though large kills of cockroaches did not occur (this is characteristic of the so-called third generation insecticides), the treatments resulted in teratological effects which would decrease the reproductive potential of a cockroach population. There was a decrease in the number of molts which occurred, as well as in the number of individuals which molted into adults. Those individuals that did not molt into adults usually exhibited characteristics intermediate between adults and nymphs. These adultoids were unable to continue further development and were, thus reproductively sterile. Many of the individuals which molted into adults were also found to have abnormal characteristics. Adult males exhibited deformed external genitalia, which are necessary for copulation, and also did not respond to sex pheromone. In addition, adult females did not produce oothecae, suggesting they were also reproductively sterile. In general, the majority of these effects would cause a decrease in the reproductive potential of a cockroach population.

In terms of the use of pheromones as control agents, it is important to know precisely what behavior is elicited and the perceptual mechanisms involved when cockroaches are exposed to sex and aggregation pheromone. Using a styrofoam Y-ring globe apparatus, orientation movements of cockroaches carrying the globe was observed. The antennae are the primary chemosensory organs; therefore, head and antennal movements were analyzed using a frame by frame analysis of 16mm. cinematography. Both control sequences and sequences in which males were exposed to sex and aggregation pheromone were filmed.

Male cockroaches responded to sex pheromone on the globe by increasing the rate of locomotion, whereas exposure to aggregation pheromone decreased their rate of locomotion. In addition, there was a significant orientation of males towards sex or aggregation pheromone when the sources were placed on the right or left side of the cockroach. Females oriented positively toward the aggregation pheromone.

The analysis of head and antennal movements also demonstrated specific changes in the head and antennal positions in response to sex and aggregation pheromone. Three components of the position of the antennae were altered: 1) the antennae are elevated off the substrate; 2) the antennae then spread apart; 3) the head turns toward the pheromone source. These changes in movements were such that the cockroach increases the area scanned by its sensory organs so as to increase input from the environment. All of these experiments were performed with the pheromone source in close proximity to the cockroach, where chemotropotaxis can be utilized for location of a point source of pheromone. We are presently initiating experiments to determine how the cockroach located this zone where chemotropotaxis can be used. Experiments will include arena studies, which will attempt to simulate room-like conditions where this system must function.

With respect to both hormonal control or pheromonal control of a species, it is important to know the natural structure of populations and what affects the behavior of entire populations. This is especially important because many of the control methods are sex or age specific. Thus, the ecology group set out to determine some of these parameters. Using _Blattella germanica_, we have found that population size affects the amount of movement, with small populations showing less frequent movements than large populations. There is also a correlation between population size and amount of aggression, with larger populations having aggressive encounters which are more intense. Although it is impossible to prove directly that dispersal in B. germanica is promoted by the increased aggressiveness in large populations, this is the most likely working hypothesis.

A capture-recapture analysis of a natural population of Periplaneta americana was performed throughout the summer. Traps were baited with a non-aromatic bait and provided with water for maintenance of cockroaches. The study generated four major findings: 1) there was a disproportionately small number of adult males in the population; 2) most movements occurred over very short distances, although longer movements were not uncommon; 3) there was a high degree of variability in the number of animals trapped each night, more than would be expected due to chance; and 4) early instar animals apparently do not participate in the same foraging patterns as adults and late instar nymphs.

In summary, we feel there is a potential for the use of these pheromones and hormones as control agents, but much more needs to be known about pheromones and hormones, in terms of the basic biology of cockroaches, before we are ready to use these in controlling cockroaches. It is important to continue to investigate these various aspects so that the most efficient use of these substances will be made.

Reference copy: Science Library, University of Kansas

****

Preliminary Population and Behavioral Study of Cetaceans in the Gulf of Maine (Grant no. GY-11454)

College of the Atlantic
Bar Harbor, Maine 04609

June 2, 1974 - August 25, 1974

Participants:

Karin Bagn	Scott Kraus*
Enno Becker	Steve Savage
Gayle Cliett	Rich Waters
Robin Hazard	Steve West

*Student Project Director

Steven K. Katon, Faculty Advisor

A study of cetaceans in the Gulf of Maine was undertaken through five projects. The Mt. Desert Rock Whalewatch and the Maine Coast Whale Sighting Network are projects that originated in 1973. The field guide, identification film and ferry/strip census projects were all started in 1974.

Mt. Desert Rock (MDR) is a U. S. Coast Guard light station located 22 miles off the Maine coast (43°58'N by 68°08'W). From August 1 to September 14, observers maintained a whalewatch from the lighthouse and recorded data on all marine mammals that appeared in the area. Observed were 32 finback whales (Balenoptera physalus), 2 sei whales (B. borealis), 1 minke whale (B. acutorostrata), 7 humpback whales (Megaptera novaeangliae), 59 fin or sei whales (discrimination between these two species was not always possible), 47 pilot whales (Globicephala melaena), 170 white beaked dolphins (Lagenorhynchus albirostris), 5 white sided dolphins

(L. acutus), 19 harbor porpoise (Phocoena phocoena) and 95 dolphins that were not seen well enough to identify. Photographs and films were taken of all animals, and they were used to confirm the dolphin and sei whale identifications. A catalog has been assembled of all whale photographs sufficiently clear to identify the species.

From the data obtained at MDR, three findings stand out. 97% of the dolphins observed in September were heading SSW, a strong indication of a southerly migration at that time.

There appears to be a correlation between the herring catches and presence of whales. Seiners in the MDR area reported the absence of fish in the last 10 days of August, a time when only one whale was sighted by our observers.

Also notable is an apparent connection between rough weather and breaching behavior in humpback whales (M. novaeangliae).

Maintenance of MDR as a whalewatching station for several years might lead to more conclusive results from both migration and behavioral studies.

The purpose of the Maine Coast Whale Sighting Network (MCWSN) is to gather information on the distribution and abundance of cetaceans along the coast of Maine from people who work, travel or vacation on these waters. It now includes over 150 volunteer observers. A total of 126 separate reports recording a total of 330 cetaceans was recorded from March to November, 1974. Positively identified were 43 harbor porpoise (P. phocoena), 2 pilot whales (G. melaena), 10 humpback whales (M. novaeangliae) and 4 white beaked dolphins

(L. albirostris). The remaining reports did not contain sufficient information for identification but were included in our general analysis. This study indicates a real need for a field guide, as observers who are familiar with whales report more accurate information. The MCWSN, with the aid of a field guide and an identification film, may eventually provide valuable data on cetaceans in the Gulf of Maine.

"A Field Guide to Whales in the Gulf of Maine" is nearing completion. It combines a descriptive text, sketches and when possible, photographs of the 21 species found in the Gulf. It is intended to increase the accuracy of the MCWSN and provide mariners along the coast with general information on whales. We hope to have the finished Field Guide published and ready for distribution in the early spring of 1975.

The production of an identification film showing whales in the wild has been started. It will contain footage of whales commonly found in the Gulf of Maine and will provide information on how to identify them accurately. Over 1200 feet of film were shot from Mt. Desert Rock using newly developed telescopic filming techniques. Some of this will be incorporated into the identification film, but much of the footage will be supplied by interested whale scientists around the country. The film should be available for distribution by the end of 1975.

The work at sea program consisted of two major efforts. A 22-foot power boat was in use for three weeks and provided a platform from which over 200 photographs and 400 feet of film were obtained. Although identification of whales was easy from the boat, their behavior was obviously affected.

Ferries crossing the Gulf of Maine were used in an attempt to acquire information on population numbers and distribution. The 21 crossings yielded totals of 70 rorquals, 78 pilot whales (*G. melaena*), 132 harbor porpoise (*P. phocoena*), and 208 unidentified dolphins. Analysis using variations on formulae by Doi (Doi, 1971), results in a population estimate of 355 rorquals present in the Gulf of Maine. Though this estimate is the first of its kind for the area, it is highly approximate and should be regarded cautiously.

Reference copy: College of the Atlantic Library

****

A Survey of Great Blue Heron Rookeries along the Oregon Coast (Grant no. GY-11420)

University of Oregon
Eugene, Oregon 97403

April 15, 1974 - September 15, 1974

Participants:

Randy Eisendorf
Scott English
Elizabeth Gassel
Mary Leitschuh
Ellen McMahon*
Charlotte Skibinski
Gretchen Vadnais
David Werkschkul
George Williamson

*Student Project Director

Paul Rudy, Faculty Advisor

The main goals of this project were to locate the major heronries on the Oregon Coast and to collect data on breeding success and habitat requirements, so that recommendations could be made about future land management. These recommendations concern buffer zones around existing heronries and the preservation of suitable alternate nesting areas nearby in cases where sufficient disturbances to cause abandonment were imminent.

During the 1974 breeding season, 13 heronry sites were located with the assistance of the 1972 Audubon survey, the U. S. Forest Service, the Oregon Wildlife Commission, various timber companies, and local residents responding to requests for information in coastal newspapers. This project was done in four states: biological observation; analysis of the physical features of the nesting area; research on the history and ownership of the land; and location and observation of feeding areas.

The biologists were primarily concerned with the dates of significant breeding events throughout all of the coastal heronries, and an approximation of the populations and general productivity. Because of the varied environments and locations of each heronry, as well as the time of the year that each was located, a variety of methods was used.

The coastal zone was divided into three sections and one biologist worked on the heronries in each area. In most situations, visits were made at least once a week during April, May, and June. Observations were made from the ground and from blinds built in trees at the periphery of the heronry. Data concerning the number of active nests, number of young per nest, infant mortality rates, and times of major events in the breeding activities were collected, as well as general behavioral notes. No attempts were made to climb trees containing nests. To our knowledge, breeding activities were not hampered by our presence.

The goals of the foresters were to determine the locations of each nesting tree, the positions of natural and man-made landmarks, such as ridgetops, bodies of water, and roads, in relation to the heronry, and the topography and vegetation of the immediate area. These landmarks aided in locating the heronries on existing contour maps; they play an important part in determining buffer zone boundaries.

The species of each nesting tree was noted, along with the tree number, diameter and height. Sketches were drawn up for the cartographers, who sketched cross sections of each nesting area. Trees with nests were tagged and numbered with aluminum plates when land owners' permission was granted. These tags will facilitate future observations of the heronries.

The landscape students drew maps and illustrations to aid in the interpretation of data concerning the habitat. They were drawn directly from information collected by the surveyors. This information consists of immediate topographical data of the heronry itself, location, height, and species of nesting trees, and a list of associated vegetation. The maps correlate with the biological data and will also be of use in relocating trees for further study.

These students also used records in the tax assessors office of the county courthouses to determine the ownership of the land containing the heronries. Once the ownership was established, the owners were approached to find out what plans, if any, they had for the land on which the heronry was located. In all cases, people were receptive and willing to discuss what would happen to the different heronries. However, it was not always possible to obtain a specific answer. The only heronries for which the future land use is specifically known are on the Rogue, and Columbia Rivers. These will not be cut. The U. S. Forest Service is currently using the data from this study to write a policy about the management of Great Blue Heron nesting colonies on their land. For the others, there has been no commitment on the part of the owners.

The portion of the project dealing with feeding areas was not included in the original proposal, but was found to be a necessary addition to studying Great Blue Heron habitat. The purpose of this section of the study was to locate and record some of the areas used by the Great Blue Heron to feed. This was done by students who traveled along the banks of rivers, estuaries, sloughs, inlets, and marshes, recording instances of feeding herons. The feeding areas were designated on various maps and short descriptions of areas used by herons were recorded for further mapping. Observations were made with 7x35 binoculars and a spotting scope with a 60 power zoom lens. Areas were observed between June 25 and August 23.

Thirteen active heronries were located in the coastal region of Oregon in the 1974 breeding season. The total number of active nests was 885. The average number of nests per heronry was 68 (range 15-175). Six of the heronries had nests constructed predominantly in sitka spruce, 5 in red alder, one in hemlock, and one in live oak. The tree heights averaged

82' (range 40'-125') in the sitka spruce/hemlock heronries 68' (range 55'-100') in the alder heronries, and 49' in the heronry built in live oak.

Eight of the 13 nesting areas were in canyons or stream beds, three were in relatively flat areas, and two were on islands. The average area containing nests was .9 acres (range .2-2).

The percentage of active nests compared to the total number of nests was determined at eight locations. The percentages of constructed nests which were active seemed to be directly related to the amount of disturbance to which the area was subject.

In five areas which showed no signs of past or recent disturbance, 92 to 97.8 percent of the nests contained a breeding pair. Three areas with nest activity of 61 percent, 64 percent and 78 percent show evidence of obvious disturbance. The heronry with 61 percent activity had a logging road constructed within 80 feet of the nests, logging nearby during the breeding season, and 3 adults shot at the nests. The heronries with 64 and 78 percent activity had clearcutting within 100 yards in the last 10 years, which made the surrounding trees susceptible to blow down, and caused the trees with nests to be visible from the road. Thirteen young birds were shot at one of these heronries, perhaps because of the exposure and easy accessibility by humans.

The average arrival time was the first week in March (varying from early February to mid-March). The average first hatch was the second week in April (range March 20 to April 25), the average peak hatch was the first week in May (range April 17 to May 14), and average peak fledging period was the first week in July (range June 20 to July 15). The intervals between events suggest that there is a two to three week period of roosting, courtship displays, and copulation, and a four week period of incubation. These intervals also suggest that the young are eight to nine weeks old before short flights are made from the nest. We considered this period of short flights to be the fledging date, although the young were seen to return to the nest until they were 11 or 12 weeks of age.

The pairs which began nesting earliest fed their young for longer than the pairs which nested later. The average number of young fledged successfully per nest at five heronries was 2.3. This compares with the 2.0 found by Ives in California (1972), 2.6 found by Henny and Bethers in Albany (1971) and 2.51 found by Vermer in Alberta (1967). Pratt (1970) found 1.5-1.7 young per nest because of the smaller clutch size found in the more southern locations.

Since egg counts were not obtained this season, we calculated nesting mortality rates by using the clutch size obtained by Henny and Bethers at Albany (1971) of 4.19. Assuming this to be the average clutch count at the five heronries, an average of 43.4 percent (range 36.7 to 51 percent) of the young died between egg laying and fledging. The most common ages of death were from three to five weeks old. Whole broods of young were found dead in the nest (perhaps from disease) or below the nest (perhaps from high winds).

Of the 13 heronries observed six are located less than a mile from shoreline areas suitable for feeding. Five are located less than five miles from identified feeding spots. Two are between five and 10 miles from any large body of water.

A number of generalizations can be made concerning the specific habitat requirements of Great Blue Herons along the Oregon Coast, based on these results. The percentage of nesting colonies found in canyons in this study suggests that ridges may play an important role in deflecting or absorbing the shock of the wind. The vegetation may be an essential element in the productive quality of the ridges. In some cases, the sheltering effect of the ridge is destroyed by the removal of its timber. In three areas where logging and road construction have come within 200 yards of a heronry, the nests nearest the disturbance have been abandoned. In two instances, recent road construction provided easy access to the nests. At these sites, three adults, and 13 young were shot this season. The heron's large size, concentrated nesting colonies, and the inability of the young to leave the nests make them easy targets. Shooting deaths are not uncommon when nesting sites are easily visible from a road.

There are two approaches which could be taken to assure a stable Great Blue Heron population. One is to preserve the natural buffer zones surrounding the existing heronries, which protect the nesting colony from wind damage and human influences. The second is to set aside areas in the immediate vicinity which meet the habitat requirements of the existing heronry before it is disturbed.

Reference copy: Science Library, University of Oregon.

****

Black Bear Population of the Yosemite Valley and Human-Related Behavior (Grant no. GY-11526)

University of California, Berkeley
Berkeley, California 94720

June 30, 1974 - September 8, 1974

Participants

Randall Buettner	Ellen Kaye*
Stephen Bundy	John Loquvam
Eric Dinerstein	Duncan McElfresh
Joan Duffield	Karen Shimamoto

*Student Project Director

John R. Parmeter, Faculty Advisor

Black bears (Ursus americanus) are a major attraction at Yosemite National Park. However, their close contact with man has resulted in thousands of dollars in property damage each year and some incidents of personal injury.

The three project objectives were: to estimate the size and characteristics of the bear population in Yosemite Valley; to examine bear feeding habits, particularly the proportions of natural and non-natural foods; and to determine if new bear behavior patterns have emerged in response to human-induced changes of the bear environment.

In addition, in response to an increasing number of bear incidents, and at the request of Chief of Resources Management, Richard Riegelhuth and Resources Management

Specialist, Herb Sansum, members of the group assisted in the implementation of the Park's new Bear Management Plan. Three project members were dispatched to Tuolumne Meadows and a fourth went to White Wolf; their part in management actions was to help identify depredating bears.

The black bear population of Yosemite Valley was estimated both by the Lincoln-Index Method and by absolute count over a period of intensive observation (July 1 - July 28, 1974). The estimated bear population was 32 both by direct count and by averaging the results of the first two Lincoln Indexes. The third and fourth Lincoln Indices are considered invalid due to uncertainty in the number of identified bears.

The bear population of the Valley was transient, remaining in the area for a period of time and then moving out. From observation records during the project director's spring internship in Yosemite, it could be seen that the bear population existing in the Valley during July was different than the Spring population. Similarly, at the conclusion of the project's intensive observation period, there was another influx of bears and an exodus of some previously identified bears.

Bear populations existing in the Valley, and in the vicinities of both Toulumne Meadows and White Wolf Campgrounds are larger than naturally existing populations would be. Natural food sources in the Valley are not sufficient to sustain 32 bears, and the bears rely on non-natural food sources for added sustenance. An analysis of Valley scats indicated garbage present in 38.3% of those collected, while in Tuolumne 75% of the scats contained garbage. The Valley contains better bear habitat than do the higher elevations, such as Tuolumne Meadows. Natural food items in the Valley included acorns (_Quercus_ _sp_), berries (_Rubus_ _sp_. and _Ribes_ _sp_.) dogwood (_Cornus_ _sp_.), and apples (_Malus_ _sp_.) which are not naturally-occurring but remain from previous orchards. At higher elevations, most of these food items, with the exception of berries, are lacking.

Observations of Valley dumpsters indicated that dumpsters were used quite extensively by some bears and to a lesser degree by others. During one two-week period, five of the 23 identified Valley bears were observed rummaging through one particular dumpster nearly every night. This dumpster was of the type which had no lid and was located in close proximity to a heavily populated visitor-use area. The no-lid dumpsters, owned and maintained by Curry Company, were found to attract bears and presented a hazardous situation since they were usually located near populated visitor areas. These dumpsters should be changed to the bear-proof type which were found to be completely successful in preventing access to garbage.

In addition to dumpsters, bears obtain non-natural food through "bum behavior", such as stealing food from picnic tables and breaking into cars. The number of bear incidents was considerably larger in 1974 than in 1973; however, this is partly attributable to increased priority in reporting bear incidents. Property damage increased from $24,367 in 1973 to $41,056 in 1974. Much of this damage involved vehicles in the Mather District. Of the 249 vehicles damaged in the Mather District, 149 or 60% had food stored inside the car proper, i.e., not in the trunk. Efforts at visitor education by the NPS are lacking; training could go far in reducing property damage if directed towards proper food storage.

Non-natural food sources appear to be important to bear survival, so that both in the Valley and Tuolumne Meadows, bears would establish "feeding ranges" involving dumpsters and were willing to defend these dumpsters to some degree. This defense, however, was observed to involve only hissing or the threat of physical violence, but never physical violence itself. Establishment of "feeding range" was believed to be density dependent--as the bear density increased there was more pressure to establish "feeding ranges."

The intent of the Bear Management Plan was to phase out all sources of non-natural food, and to return the black bear to its natural foraging habits, population levels and distribution. Generally, the management plan was effective. It appears unlikely the bears will return to original levels, since there will always be some non-natural food sources available; however, if non-natural food sources can be eliminated the bear population is expected to decline.

By bear-proofing the dumpsters, the major source of non-natural food will be eliminated. Bear-proofing, particularly in the Valley, should be completed prior to the bears' emergence from denning. This may lead to a higher cub mortality since there will be less food, and will also prevent cubs from learning to use dumpsters as a food source. In this manner, a natural population decline to more easily sustainable numbers will begin.

Relocation of problem bears will continue to be necessary, and although it is sometimes a short term solution, it is better than the other alternatives--eliminating the bear, or not dealing with the problem.

Reduction of the bear population by natural means is preferable to killing off bears by drug overdose, as has been the case in the past.

Reference copy: Agricultural Sciences Library and School of Forestry and Conservation Library, University of California, Berkeley.

****

An Urban Heritage: The Documentation of Troy Music Hall

(Grant no. GY-11541)

SUNY-State University at Albany
Albany, New York 12222

June 3, 1974 - August 28, 1975

Participants:

Daniel Beinart*
Thomas Scott Cantrell
Alice DeSorbo
Keith Frezon
Diane Gurdak
Wayne Gustavson
Michael Martell
Stephen Pollak
George Runkel

*Student Project Director

Jack H. Smith, Faculty Advisor

The purpose of this study was to establish in quantitative detail both the objective and subjective properties of the acoustically-renowned Troy Music Hall, in Troy, New

York. The motivation for our research was the feeling that if a thorough analysis were made of the Hall and effectively communicated to the scientific community and the general public, a cultural jewel would become more useful. The research was divided among several subgroups, working in each of the following areas: physics, chemistry, computer science, and of course, music.

The physics subgroup made an acoustical analysis of the Hall, using several measurement techniques. A thorough mapping of reverberation time as a function of frequency and position was successfully completed. The great majority of these measurements was obtained using the conventional interrupted-noise method; some of the resulting audio data were stored on magnetic tape for use in further study. The overall trend of these reverberation time determinations shows a hump centered about the mid-range frequency, with a decrease into the lower frequencies and a more rapid fall-off in the highs. These trends tend to agree with the listening qualities of the hall; the maximum reverberation times of around three seconds especially demonstrate the general "liveness"of the Hall. Secondly, in conjunction with our computer programmer, we attempted a comparison of the before and after composition of a complex waveform as it undergoes a single isolated wall reflection. Our method was, of necessity, quite crude and roundabout, and the results of this study remain inconclusive, mainly because of problems in electro-acoustical transduction and A-D conversion for the Fourier Analysis program required.

The chemistry subgroup was involved in an historical pollution study, analyzing particulate matter collected mainly from behind the Hall's long-unused pipe organ. To determine the metals present in the dust collected, two methods were used: emission spectroscopy, to determine which elements were present; and atomic absorption, to obtain precise percent compositions. From these analyses, the following elements were found to be present: Ca, Si, Al, Fe, Mg, Na, and several others, down to small trace quantities.

The musical subgroup endeavored to demonstrate the Hall's excellent acoustical qualities through the use of recordings of live performances. As one of the performances planned involved the Hall's venerable organ, the task of putting that instrument in good working order came first. An inoperative blower motor was reparied, considerable leak-patching and action-adjustment was accomplished, and a thorough retuning was completed, which put the organ in quite workable condition. Quadraphonic recordings of performances on this and other instruments, both solo and in small groups, were made. These include: a jazz quartet, harp, choir, string quartet, piano, harpsichord, and organ. These recordings exhibit a wide variety of musical timbres and repertory in the Hall.
Reference copy: SUNY-State University at Albany Library

****

Rural Waste Collection and Disposal in Lincoln Parish, Louisiana (Grant no. GY-11481)

Louisiana Tech University
Ruston, Louisiana 71270

March 15, 1974 - April 1, 1975

Participants:

Keith Belton
Thomas Buckman
Johnny Craig
Mike Cranford
Gary Faulkner
Steve Fitzgerald
Bobby Kranz
Danny Martin*

*Student Project Director

Bobby E. Price, Faculty Advisor

In recent years, the problem of rural solid waste collection and disposal in Lincoln Parish has been a major concern of its citizens. Although the cities and towns have organized collection systems, rural collection has not been attempted within the Parish (County). Traditionally, a large portion of the rural population in Lincoln Parish has dumped its trash into the nearest available ditch or wooded area. However, this dumping has become an eyesore, as well as an unsanitary situation. The Solid Waste Management Committee of Lincoln Parish has recommended a system which would help control this problem. The system would consist of metal containers distributed on roads and highways throughout the Parish.

The objectives of this project were to determine the locations of these containers, to design typical container sites, and to propose methods of informing the public of the proper use of the containers.

To determine the proper locations for the sites, population density and distribution were determined throughout the Parish by individual groups driving each road in the

Parish and indicating on maps the location of every populated house in every section of the Parish, except those within incorporated city limits. Centers of population density determined the general locations of the container sites. Also taken into account in the placement of the container sites were the location of the major traffic arteries, intersections and traffic hazards.

A computer program was written to assist in designing an efficient collection system for the contents of the containers. The Parish was divided into five districts. The computer program was designed to provide the optimal routing for the collection vehicle through each district.

Container site design and construction costs were studied. Two designs were selected for use in the collection system. Drawings and scale models of the planned sites were made to help with the final design work of the project and to illustrate some of the construction details.

The last area of study on the project dealt with the various methods of educating the rural citizens of the Parish in the proper use of the waste containers. A three-phase approach was proposed for the education program:

(1) Pamphlets should be distributed to all homes in the Parish served by the system. This pamphlet should completely describe the rural solid waste system.

(2) Articles should be put in the Ruston Daily Leader , the most widely read newspaper in the Parish, and should include the recommendations made by the NSF

project team and the Lincoln Parish Solid Waste Management Committee. Progress reports should be run in the paper, with emphasis placed on construction schedules and the official starting date for the system.

(3) Road signs should be erected on all Parish roads stating the distance from the sign to the next container. Signboards should be erected at all container locations to inform the citizens of pick-up dates, container capacity and in case of a full container, the distance and direction to the next container.

Voters have approved the Rural Waste Collection and Disposal System for Lincoln Parish. Results from this project are being used to initiate the system.

Reference copy: Prescott Memorial Library, Louisiana Tech University

****

Post-Fire Successional Patterns in Coniferous Forests of Minnesota (Grant no. GY-11480)

St. Olaf College
Northfield, Minnesota 55057

June 16, 1974 - August 26, 1974

Participants:

Nancy Baker	Linda Olsvig*
Todd Bierbaum	Gary Saxton
Steven Le Clerq	Elaine Stowe

Ellen Winter

*Student Project Director

Howard D. Orr, Faculty Advisor

Introduction

This project was undertaken to study the effects of wildfire and prescribed burns on the process of succession in the red and jack pine forests of northern Minnesota. Measurements of herb, shrub, and tree cover, and of insect and soil arthropod species diversity, were compared to determine which best reflected differences due to fire. The ultimate goal of the project was to use these parameters to establish patterns of succession following forest fire. Our basic hypothesis was that the values for measurements of community structure differ significantly between burn sites and comparable unburned control sites, with the differences becoming more marked with increasing severity of fire.

Wildfires are classified in three categories by the forestry service:

1. Crown fire: the most severe fire, burning all ground cover and surface debris down to mineral soil, burning in the crowns of trees and killing most trees;
2. Ground fire: intermediate in severity, a slow-moving fire which burns ground cover and surface debris to the mineral soil, but not crowning in the trees;
3. Surface fire: the least severe fire, moving quickly and burning only the ground cover and surface litter without penetrating to the mineral soil or crowning in trees.

We pooled ground and surface wildfires as "non-crown" fires for study purposes because of the difficulty in distinguishing between them. In our study of prescribed burns, we used two categories, roughly parallel to ground and surface fires.

1. Summer periodic: parallels ground fire, an experimental burn conducted in the driest part of late summer or fall, penetrating closest to mineral soil;
2. Dormant periodic: parallels surface fire, conducted in late spring or early summer, when the ground is wet, so that fire does not penetrate far into the soil.

Sites studied included four summer periodic and four dormant periodic burns, in Cutfoot Experimental Forest; four crown fires and two non-crown fires in the Bemidji, Minnesota area.

Methods

Twenty five sampling points per site were used as the basis of study, located by random-start selection, using transect lines run by compass within an approximately 200 m. X 100 m. area in each burn site. This established fairly representative coverage of each site, with a minimum number of sample points.

Herb cover was determined by dry weight biomass, both total and by species, within 25 ($\frac{1}{2}$ x 1) m^2 plots.

Shrub cover was determined by line intercept method--the decimeters of transect line paralleling shrub ground cover by species--on the basis of 25 (20 m) transect lines.

For prescribed burns, eight milacre circular plots had been monitored on each site between 1959 and 1969, to which we added our 1974 measurements. This provided a 15-year record of shrub stem numbers and volume per site.

Trees were measured by the Curtis point-quarter sampling method at the 25 points established by random-start methods. Measurements of density (as mean distance from the sampling point) and diameter breast height (dbh) were recorded for trees, saplings, and seedlings, where present.

Insect species diversity was based on 25 sweeps with an insect net at each of the 25 points, using the Shannon-Weaver index $\bar{H}$.

Soil arthropod species diversity was measured on the basis of 24 Berlese funnel extracts per site, using $\bar{H}$ as the index.

Edaphic factors were limited by confining our study to sandy and sandy-loam soil. Prescribed burn sites were dominated by red pine; wildfires, by jack pine.

Results

Significant differences did occur between different fire types. Vegetation appeared to best reflect the effects of fire.

The point-quarter data for wildfires show that density generally increases with severity of fire, with regrowth after crown fires generally much more dense than both non-crown and control sites. (Probability of significant difference = 99.9%)

For shrubs, increasing severity of fire corresponds to decreased ground cover. The 15-year records for prescribed burns show a tendency for summer periodic burns to depress regrowth after fire for a period of several years.

Herb biomass shows no consistent pattern in prescribed burn severity, but shows a statistically significant positive correlation with severity of burn in wildfires. Highest values are obtained for the most recent fires, indicating a possible correlation with the increase in available nutrients after a fire.

Insect species diversity shows no consistent pattern in prescribed burns, but in wildfires, the crown fires have, with one exception, higher $\overline{H}$ than the controls, and non-crown fires have lower $\overline{H}$ than the controls.

Reference copy: St. Olaf College Science Library and Itasca Biological Station Library.

****

Ecological and Biochemical Aspects of Deer Foraging and Forest Regeneration (Grant no. GY-11522)

Harvard University
Cambridge, Massachusetts 02138

June 10, 1974 - August 17, 1974

Participants:

Frank Benford
Ronald Bick
Marc Blank
William V. Bleisch
Michael Dornbrook
R. Patrick Hassett
Steven A. Kalinowski
Duane A. Kolterman
Evelyn Snyder
Jay J. J. Szalanski*

*Student Project Director

Marcia Evans David Weed

William H. Drury, Faculty Advisor

The Quabbin reservoir is the major supply source of drinking water for metropolitan Boston. It is managed not only for watershed efficiency, but also for timber production. Presently, the foresters are faced with a conflicting situation between timber production and watershed efficiency, in which the deer population is being used as the balancing wedge. This situation can be summarized as follows: thinned forests supply more water run-off than unthinned forests; a high deer population reduces the regeneration of forested areas after timber cutting. Therefore, should a high deer population be maintained to reduce forest regeneration and increase the efficiency of the watershed; or will a high deer population reduce the forest regeneration to the point that it eventually destroys the timber producing capacity of the forest? This project looked at some of the effects of deer forage upon the forest community and at deer foraging behavior.

Field observations of deer were carried out at 4-8 o'clock in the morning and again at 4-8 o'clock in the evening daily from tree blinds constructed. Following the morning observations and extending through the early afternoon, project members carried out plant sampling and collection of specimens for analysis in the laboratory.

The data suggest that deer are more likely to forage in areas of high productivity than in areas of high plant biomass. The rank order of six sites was compared by minutes of deer observations in the site, percentage of plant coverage above two meters, and percentage of plant coverage in the 5cm. to 50cm. area above the ground. Plant coverage above two meters is inversely related to the amount of sunlight reaching the forest floor. This percentage is also inversely related to the productivity of the plants in the area, because of the reduced energy of incident sunlight available to plants in areas of high canopy coverage. The percent of plant coverage between 5cm and 50cm from the ground was measured as an index of plant biomass available to the deer. The deer observations indicated that foraging deer spent more time with their heads in this height range, than in any other height range observed. Both plant coverage percentages for the six sites were based upon the average percentage of cover of multiple five meter diameter circular sampling plots taken in each site. We found no relationship between plant biomass and minutes of deer observations in the sites (rank order correlation 0.14), but a strong negative correlation (-0.77) between canopy cover and deer observations. The negative canopy correlation can be translated into a positive 0.77 correlation of percentage sunlight on the forest floor with deer observations.

Increased sunlight and plant productivity result in an increased plant energy content, an important parameter in animal foraging strategies. Our chemical analysis of plants eaten by the deer, however, did not demonstrate a relationship between deer preference and plant protein, carbohydrate, and lipid content.

We counted the leaves on all witch hazel plants, _Hamamaelis virginianis_, a shrub often eaten by deer in our area, in a 78 by 24 square meter zone in the study site. This leaf counting was done to determine whether a "nearest neighbor" factor affected the rate of deer predation on this shrub. Witch hazels in clusters near other witch hazels suffer a greater rate of deer predation than plants that exist away from other witch hazels, with leaf number being considered as an index of the shrubs' visual conspicuousness to the deer. We found the percentage of leaves lost by witch hazels in clusters of more than one individual per square meter to be significantly greater than that lost by witch hazels in lesser densities ($p < .05$ on one sided t-test). These data suggest that there is a nearest neighbor factor affecting deer predation on witch hazels. That this predation is a result of the plant's visual conspicuousness to the deer is obscured by our finding of no substantial difference in predation on more conspicuous plants, as defined by number of leaves present, and less conspicuous plants ($p < .25$ on sided t-test). A larger study plot for this part of the project will be needed to substantiate the relationship of the nearest neighbor to deer predation, and to elucidate the mechanism that the deer are using to discriminate the presence of witch hazels.

We were interested in determining whether deer were affecting forest regeneration by reducing seedling survival, or by "pruning" back seedlings to a certain height. To analyze this situation, we collected oak seedlings which were less than one meter tall from three sites: one which was selectively cut the summer previous to our study, an adjacent site, similarly cut 10 years prior to our study, and an area 90 miles away at the Harvard Field Station, in Concord, Massachusetts, a peripheral suburb of Boston. We considered the latter site to be a low deer foraged site. We limited our study to white oak seedlings, because our analysis of plant cuticles in deer feces revealed that white oaks were the predominant tree species eaten at that time by deer.

Various dimensions of the seedlings were recorded, with seedling age determined by ring count from microtomed root sections. We did not find any meaningful differences in shoot weight; root length regressed to age for the three areas. We did obtain a high correlation ($r > .70$) of root dry weight to age for all three sites when the data were fit to a power function. The regression line plotted on log-log paper yielded a higher slope for the Quabbin sites than for the low deer density Concord site, indicating that root dry weight increased at a greater rate with age in the high deer areas than in the low deer area. This increased rate may result from the plant's re-allocation of energy from shoot tissue (which would normally be eaten by the deer) to root development. In the presence of high deer predation, the seedlings are reducing their energy investment in the short term gains of shoot development and re-investing that energy into the long term gains of increased root development. The seedlings may then "wait" until the deer population is depressed, at which point, the developed root then serves as a "financial" basis for nutrient collection for the seedling to quickly shoot up and outgrow the deer's reach prior to the re-establishment of deer population.

An analysis of the oak seedling age distribution for the three sites suggested a greater mean age of seedlings less than one meter in the two high deer Quabbin sites than in the low deer Concord site. This may imply that older seedlings in the low deer area were taller than one meter and hence were not collected. Older seedlings in the high deer density area may have been pruned back by the deer to below the one meter level. Admittedly, our data only suggest this difference in mean age of seedlings (12.6 and 8.2 years vs. 7.7 years) and the difference may only be an artifact of inaccuracies of age determination or of our small sample size (approximately 60 seedlings from each site).

We feel that deer in the Quabbin reservoir are reducing the regeneration of tree species to an extent, but are more likely "damping" down the height of the regenerating seedlings, seedlings which "wait" until the deer population is reduced in order to sprout up and out of the deer's forage height. Those species which fail to survive this waiting period give a competitive advantage to the longer lived hardwood species.
Reference copy: Biological Laboratory Library, Harvard University

****

Tussock Moth Damage as it Relates to Forest Management

(Grant no. GY-11461)

Evergreen State College
Olympia, Washington 98505

June 10, 1974 - August 30, 1974

Participants:

Gary Bateman
Judith Hadley
Pauline Hessing
Deborah Lev
Karen Oakley*
Ronald Olson
Martin Roush
Janet Stonington
Margaret Taylor

*Student Project Director

Steven G. Herman, Faculty Advisor

The Douglas-fir tussock moth (Orgyia pseudotsugata) periodically reaches epidemic population densities in the western United States. The outbreak occurring from 1971 to 1974 in the Blue Mountains of northeastern Oregon and southeastern Washington resulted in the defoliation of large acreages of grant fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziesii*). Other investigators have noticed that the characteristics of a site can influence the severity of insect infestation. Because forest management practices alter site characteristics, they could also affect the intensity of tussock moth damage. Data were collected from 165 plots in areas both with roads and without roads of the Pomeroy Ranger District, the northern portion of the Umatilla National Forest. The infested area had been divided by the United States Forest Service into four damage classes from the degree of visible defoliation. Plots were made in all damage classes. Data on slope, aspect, elevation, and the number, size and species of all trees, were taken. Management history information was obtained from the district office in Pomeroy, Washington. No significant differences were found between the damage classes with regard to slope, aspect, amount of solar radiation, and the density of overstory and seedlings. More intensely defoliated areas tend to be less diverse. A. grandis is dominant in Class I (the highest degree of visible defoliation), while Class IV areas are more diverse.

More diverse plots occur at higher elevations. Class I plots are less diverse and are found at lower elevations. The percentage of host wood decreases from Class I to IV. Management data included the type and date of harvest; a higher percentage of Class I plots have been harvested. Damage class was used as a constant against which the variables were compared. It was learned in the course of study that damage classes do not function as a constant, as they vary both spatially and temporally. Damage classes are misleading if it assumed that they indicate tussock moth population levels. As presently delineated, damage classes do not accurately separate the intensity of damage to host trees from density itself and are therefore, most useful for gross comparisons. Differences between the damage classes were found only with regard to the variables relating to the amount of host. Diversity dilutes host trees, and diverse areas are less defoliated. Harvest can influence diversity, and in turn, the intensity of defoliation.

Reference copy: Evergreen State College Library
****

The Chemical Basis for the Inhibition of Feeding in Insects

(Grant no. GY-11476)

Illinois Institute of Technology
Chicago, Illinois 60616

May 20, 1974 - August 9, 1974

Participants:

Barbara Brown
Patrick Daly
Suzanne Findlay
Richard Hardy*
Lawrence Kopta
Larry Chih-Yi Lai
Kazys Martinkus
Wayne Thompson

Richard A. Kretchmer, Faculty Advisor

The purpose of this project was to formulate a scheme for the isolation of substances from plants which inhibit feeding in insects. From an examination of the literature several likely plants were selected for screening. A number of field trips were made to collect samples of these plants.

The plant material had to be reduced to a powder in preparation for screening. This was accomplished in a blender, either by grinding the dried plant or by blending it with water to give a thick soup. The water was then removed by freeze drying.

To devise a suitable bioassay method for detecting feeding inhibition, a variety of insects were cultured and tested: the German cockroach (Blattella germanica), the American cockroach (Periplaneta americana), two varieties of fruitfly (Drosphila melanogaster), the milkweed bug (Oncopeltus fasciatus), and the common house cricket (Gryllus domesticus). Of the methods tested, the best employed Gryllus. It was a modification of the scheme devised by K. Munakata.

For the bioassay procedure the crickets were not fed for 24 hours prior to testing. Lettuce disks were cut out; half were soaked in test solution, half in the pure solvent to serve as control. Contact prints were made of the disks and they were then placed in the cricket cages. After a set time, the disks were removed and again contact prints were made. The prints were developed, cut out, and weighed. From the weights, the amount eaten could be determined. Finally, the feeding ratio (defined by the following relation: F.R. = % Test Disc Consumed/% Control Consumed X 100) could be calculated. This value gave a quantitative measure of the feeding inhibition of a particular substance. The contact printing reduced the source of error due to evaporation from the lettuce disks (which precluded simply weighing the disks).

From the preliminary screening, two plants were selected for further work: honey locust (Gleditsia traicanthos) and a variety of juniper (Juniperus chinensis). These had the most consistent and lowest feeding ratios. Larger amounts of these plants were powdered (approximately 150 grams) and the material extracted with a series of solvents (from nonpolar hexane to polar ethanol). Extractions were carried out using a Soxhlat continuous extractor, run 24 hours for each solvent. Initial solvent volumes were two liters. After extraction, the solvent was removed in vacuo, using a rotary evaporator with the water bath temperature never exceeding 40°C. This method was used to minimize decomposition of heat labile substances.

Recognizing that in general "like dissolves like", the nonpolar substances (terpenes, for instance) would be found in the hexane extract while polar substances (sugars or amino acids, for example) would be found in the ethanol extract. Each of the solids from the extracts was bioassayed and the feeding ratio determined. From an examination of these values it was found that the greatest inhibition (lowest F.R. value) was in the hexane fraction in both plants. Since the hexane extract of *J. chinensis* was most active and gave more consistent F.R. values, it was selected for further fractionation.

The solid from the hexane extract was placed on a silica gell column and eluted with a series of solvents from hexane, hexane/benzene, benzene, benzene/ether, to ether. The column fractions were examined by thin layer chromatography (silica gell plates developed in chloroform or 10% ethyl acetate/benzene) to observe the separation of components. The components (spots on the plate) were visualized with UV light (compounds quench florescence of the plate binder) or with antimony trichloride. The latter reagent gave colored spots with a variety of compounds (typically terpenes).

From the thin layer results several different fractions were selected for bioassay. The most active component appeared to be toward the end of the series of fractions (and therefore, one of the more polar constituents). However, further investigation of these later fractions proved inconclusive. Several crystalline compounds were isolated and identified, but subsequent bioassays showed these were not the source of inhibition. Evidently the inhibitory compound was present in too low a concentration to permit complete isolation using our techniques.

Gas chromatography, infrared, and nuclear magnetic resonance spectrometry were applied to the column fractions and several constituents of J. chinensis were identified. One compound was present in large enough amounts to obtain a melting point of the recyrstallized solid. At this point the project was concluded because the time available for further bioassays had been exhausted.

Thus, in the time available, the analytic scheme was devised, the best bioassay procedure was selected, several plants were screened, and a good source plant was selected. Work with this plant, J. chinensis, proceeded through the isolation of several active components but not to the isolation of a pure compound having feeding inhibiting properties. Presumably the compound was present in very small amounts. Reference copy: Illinois Institute of Technology Chemistry Library

****

The Detection of Sulfur Dioxide-Induced Injury to Plants by Color Infrared Photography (Grant no. GY-11430)

Marquette University
Milwaukee, Wisconsin 52333

May 27, 1974 - August 16, 1974

Participants:

William Adam
Kurt Annen*
Ann Engelkemeir

Robert Gadwood
Patricia Holt
Lynn Libera

*Student Project Director

Michael Zinda

Jack E. Peterson, Faculty Advisor

Preliminary investigations by other researchers have suggested that the infrared reflectance of plant leaves is a good indicator of the health of the plant. However, very few standardized correlations between photographic evidence and actual plant injury have been investigated. It was the purpose of this research to relate the change in infrared reflectance with the type and extent of injury which the plant has received.

The environmental control team constructed and operated equipment for subjecting plants to desired concentrations of SO_2, verified the SO_2 concentration by the West-Gaeke method, and was responsible for the growing of the selected plants (radish and alfalfa). The equipment and methods are described in detail in the final report, along with an analysis of the problems encountered in controlling and determining the SO_2 concentration.

The photography section was responsible for the photography of the plants with color, color infrared (CIR), and black and white infrared (B&W IR) film, and for the film development techniques. The methods and standardization practices which were employed are delineated in the final report.

The biology team examined the plants macroscopically and microscopically so as to replicate the symptoms of SO_2 injury as reported by previous researchers, and to relate changes within the plants to changes in photographic images. Experiments were also performed to determine the effect of certain common variables on IR reflectance and to determine the mechanism of IR reflectance.

The results obtained from this research were initially of some surprise. It was found that the infrared reflectance of radish and alfalfa leaves does not change after being injured by exposure to SO_2. Through the use of B&W IR film, it was shown that the change in the image of a leaf on CIR film was due only to changes of the reflectance in the visible spectrum and to changes in the texture of the surface of the leaf which affected specular reflection. Thus, CIR film provided no new information about the health of the plant which was not already contained on color film.

Investigation into the nature and mechanics of IR reflectance showed that the internal structure of the leaf is partly responsible for the IR reflectance characteristics. Also, it was demonstrated that the IR reflectance is independent of chlorophyll, and that the epidermis contributes to it negligibly.

The macroscopic and microscopic methods of examination are presented. A discussion of the difficulty and subtleties encountered in the proper interpretation of CIR photographs is presented. And in conclusion, macroscopic color, CIR, B&W IR, and microscopic B&W photographs of control and injured radish and alfalfa leaves are included, along with photographic results of some IR reflectance experiments.

Reference copy: Marquette University Library

****

Levels and Effects of Mercury in Northern Utah (Grant no. GY-11504)

Weber State College
Ogden, Utah 84403

June 17, 1974 - August 30, 1974

Participants:

Robert J. Alley	Paul Jones
Gary V. Burton*	Paul Orton
Vance Cox	Gary L. Rasmussen

*Student Project Director

Darrell J. Graff, Faculty Advisor

In the 1950's a mysterious neurological disease affected fishermen and their families around Minamata Bay in Japan. This disease, which was characterized by progressive muscle weakening, paralysis, vision loss, and even coma and death, was traced to mercury waste effluents from surrounding factories (Goldwater, 1971).

Since this episode, mercury has come under worldwide scrutiny. However, most investigation has been concerned with clinically observable effects and only recently have sub-clinical manifestations been investigated.

Spyker showed sub-clinical behavior deviations (while swimming and open field testing) in the offspring of mice injected with 0.16 mg of methylmercury dicyandiamide (Spyker, 1972).

Determination of mercury levels, in the hair of humans and brain of Peromyscus maniculatus (white-footed deer mouse), was by flameless atomic absorption spectrophotometry with a room temperature digestion procedure based on the oxidizing principle of chromic acid in conjuction with red fuming nitric acid (Hatch and Ott, 1968, Bouchard, 1973).

Mercury in the environment of Utah does not appear to pose immediate risk to residents. We found the levels of mercury in human hair in the inhabited areas of the state was extremely low (mean levels < 2.0 ppm). In certain areas of the State that are not inhabited the level of mercury was higher (Bird Island, Badger Island, etc.). In these areas, the mercury level in hair of *Peromyscus maniculatus* was 6-8 times greater than the mean mercury levels of mice of all other areas, but would still have to be considered "low" (< 29.0 ppm).

Bird Island and Badger Island are located in the Great Salt Lake. Mercury levels in this lake are not detectable ($< .005$ ppm). However, mercury is detectable (0.5 ppm dry weight) in the brine fly (*Ephydra spp*.) which consumes algae in the lake water. Mice, living along the shoreline of the Great Salt Lake, have a diet, 60% of which is composed of the dipterous insects (Rasmussen, 1973). Therefore, through biolcgical concentration, the mice accumulate relatively high levels of mercury.

When mice from areas with the higher hair mercury levels (Bird Island, Badger Island) were compared with mice from the very low areas (Vernal), they appeared overtly normal. However, we found them to differ significantly in swimming and behavior under stress.

In the swimming tests a direct correlation (0.92 significant to < 0.01) was found between mercury levels and swimming ability. In the open field test (Hall, 1934, Whimbey and Deneenberg, 1967) there were several correlations of mean hair mercury levels to various behavioral parameters (ambulatory activity, backing, freezing, center latency). There were no correlations between mercury levels and the ability to learn simple tasks (shock avoidance).

The results obtained in this study of untreated environmental mice correlates very well with the results of Spyker who worked with laboratory mice injected with methylmercury dicyandiamide under controlled conditions. Our results show that "sub-toxic" levels of environmental mercury contamination in mice, as indicated by hair levels, are capable of causing neuromuscular and behavioral dysfunction in these mice.

We found no correlation between mice behavior and neural tissue mercury levels. This indicates that the sub-clinical deviant behavior exhibited in the mice was the result of long-term mercury exposure and not acute poisoning.

Reference copy: Weber State College Library

****

Preliminary Survey of the Plants and Vertebrates of the Wenaha Drainage (Grant no. GY-11433)

Eastern Oregon State College
La Grande, Oregon 97850

June 12, 1974 - August 25, 1974

Participants

Michael Ferro	David Nichols
Karl Hulbert	Jaylen Reed
John Merrill	Keith Roberts

James Merzenich* Avery Taylor
*Student Project Director

Conrade Head, Faculty Advisor

The Wenaha drainage, a 200,000 acre roadless area, lies in the Blue Mountains along the border of Oregon and Washington. Interest in the future use of this area has arisen among conservation groups, lumber interests and the U. S. Forest Service. To provide information for the management of this region, this study was conducted with the following objectives:

1. to investigate and classify the vegetation on an ecosystem basis;
2. to determine vertebrate species present and their distribution within vegetation habitat types;
3. to obtain baseline data so that changes in the biota can be correlated with environmental management practices.

Field work was conducted in a 6,000 acre study area, believed to be representative of the entire drainage. Homogeneous stands of vegetation were found and sampled using plots and transects. Vertebrate species were trapped or observed and associated with the vegetation.

Where extensive homogeneous stands of vegetation were found, our data compared favorably with that of other researchers. Much of the study area, however, has a varied topography which causes certain critical physical factors to vary within a quite limited space. This produces a complex mosaic of different plant associations. Areas which are continually disturbed, as by overgrazing, may exhibit characteristics of their normal climax vegetation only after a long period of recovery. These areas presented us with difficulties of method, if not of identification, and required the greatest amount of our attention and reflection.

Meaningful correlation between vertebrate species and this complex mosaic of vegetation was difficult to obtain. When a suitable habitat for a certain species does exist it is often small in area and separated from other similar areas by barriers. These factors seem to limit the distribution of small mammals especially. In all, 27 species of mammals, 85 species of birds, and 12 species of herpetiles were found.

Of special significance, the first recorded sightings of barred owls (_Strix varia_) in Oregon were made and the known distributions of other vertebrate species were extended. An orchid of the genus _Habenaria_, which has never previously been described, was collected.

A photographic slide collection and a collection of preserved vascular plants and mammals is available for reference at Eastern Oregon State College.

Reference copy: Eastern Oregon State College Library.

****

Missoula Valley Air Pollution Study (Grant no. GY-11415)

University of Montana
Missoula, Montana 59801

June 25, 1974 - September 14, 1974

Participants:

Robert Bohac
Robert Hoedel
Harold Robbins
Michael Sully*

*Student Project Director

Susan Larsson Kelly Tatchell
Dan Olsen Terry Wheeling
R.E. Erickson, Faculty Advisor

The Missoula Valley Air Pollution Study was comprised of four interrelated projects. The first was initiated to investigate any possible statistical correlations between various air pollution indices (i.e., particulates, total suspended sulfates and benzene soluble compounds), or various meteorological variables (i.e., temperature, wind speed, humidity and precipitation) and adverse health effects, as measured by hospital admissions for respiratory illnesses. A non-parametric rank correlation test was used as the primary investigative technique.

Moderate to strong correlations between soluble sulfates and hospital respiratory admissions were found. Numerous correlation coefficients in excess of .50, significant at the 5% confidence level, were obtained for different categories of respiratory diseases and age groups with various indices of soluble sulfate levels. The strongest correlations occurred for admissions of people in the youngest and oldest age categories. Soluble sulfates and respiratory admissions correlations are highest for the winter months. Benzene soluble particulates appear to be moderately correlated with hospital admissions, but for different seasonal periods than soluble sulfates and probably different age groups. Total particulate levels were not correlated with hospital respiratory admissions.

The second project consisted of the determination of particle size distribution and chemical analysis of the particulate associated with paved and unpaved streets for cadmium chromium, lead, iron and sulfate content. Sampling was carried out at eight sites in the Missoula Valley and at two sites outside of the Missoula Valley. Significant concentrations of lead and soluble sulfate were found, especially in the sub-micron size region.

The third project was concerned with the box model for the Missoula Valley Airshed developed by W.R. Derrick of the University of Montana Mathematics Department. Initial calculations, based on available meteorological data, showed the box model to be a better model for anticipating pollutant concentrations in the Missoula Valley than the more widely used Gaussian Plume model. In order to calibrate the box model, temperature inversion heights and wind movement during inversion periods had to be determined. This project consisted of developing the necessary methods for obtaining wind and temperature profiles. The results of this project showed that the single theodolite method cannot be relied upon to yield accurate results for wind velocity determinations. The double theodolite method was chosen as the technique to be used for the measurement of low altitude temperature profiles. Computer programs were written to reduce the large volume of data generated by using the double theodolite method. Collection of temperature inversion height and wind velocity data in the Missoula Valley will be continued for the period of at least one year by members of the Student Environmental Research Center. These data should provide a basis for the calibration of the box model.

The fourth project was an investigation of photochemical oxidants and nitrogen oxides. The total oxidant concentrations were determined using the Neutral Buffered Potassium Iodide method. Nitrogen oxides were measured using the method of Saltzman. Recorded levels of photochemical oxidants and nitrogen oxides were considerably below the Federal ambient air standards. Maximum levels in Missoula were about half the Federal standards. While photochemical oxidants probably pose no immediate threat to life in the Missoula Valley, the oxidant levels are significant and could probably increase with local economic and population growth. Recorded levels of oxidants are probably lower than average due to unseasonably wet weather the summer of 1974. The conifer forests in the area probably contribute photochemical reactants to the pool of anthropogenic precursors in the valley. Their exact contribution cannot be ascertained without further study.

Reference copy: Main Library, University of Montana

****

Nitrogen-Fixing Properties of Azotobacter relating to Agricultural Supplements (Grant no. GY-11440)

Heidelberg College
Tiffin, Ohio 44883

June 3, 1974 - August 14, 1974

Participants:

Clinton Beckert
Loren Hintz
Vicki Hohman
Mary Ann Kucera
Annette Mader
Kevin Meyers
Susan Orosz
Elizabeth Smanik*
Carol Walton
Tom Williams

*Student Project Director

Percy Lilly, Faculty Advisor

Nitrogen is the most prevalent element of those having metabolic requirements in living organisms. Although this gas constitutes 78.89% of the air, the process of the reduction of atmospheric nitrogen to forms suitable for growth is of limited efficiency. Sources of available reduced nitrogen are: from the spontaneous ionization of air, i.e., lightning; through the decomposition of organic wastes; and from nitrogen-fixing strains of bacteria. Azotobacter is a non-symbiotic, aerobic gram negative bacterium which is able to fix nitrogen to a limited extent. The large demand for carbon by Azotobacter indicates a system rich in energy output. A more efficient output of usable nitrogen by these types of nitrogen-fixing bacteria could provide an alternative to present inorganic fertilizers. Major grain crops require a slightly alkaline soil. Azotobacter is most efficient in this pH range.

Several aspects of the community problem of nitrogen utilization as related to agricultural supplements were examined. Land from twelve local farms was studied with respect to soil micro- and macroorganisms. Collection plots consisted of fertilized, agriculturally-active sites, as well as ones which were maintained in the inactive state. The only difference between the two types of plots was that, for a minimum of five years, the latter had received no fertilizer or cultivation. Organisms were counted and classified.

The major thrust of this project involved a comparison of nitrogen-fixing abilities between nonmutated and induced mutant strains of *Azotobacter chroococcum* . Ultraviolet irradiation for intervals of 15-20 seconds produced a reduced colonial growth of the strain. Graphical interpretation of the relationship between percent survival and exposure time indicated 99% cell death. This technique was the means used to measure induced mutation. The Kjeldahl method was used to determine the organic/soluble nitrogen content of four different sample types: uninoculated blank media plates; plates containing parent cultures; plates containing induced mutants; and soil samples. The agar samples necessitated a sodium thiosulfate modification of the standard Kjeldahl method to determine the soluble nitrogens present. Soil samples required a modification based upon Devarda's alloy.

A third part of the project was a study of the shortage of fertilizers in Seneca County. Surveys regarding fertilization habits used in connection with two crops, corn and winter wheat, were circulated to half of the agricultural community. These crops were selected because they require large quantities of available nitrogen. Alternate methods of agricultural supplementation, such as organic farming and the use of biologically active supplements, were extensively examined for comparative evaluation.

In general, the average number of soil organisms, both macroscopic and microscopic is consistently higher in unfertilized soil plots than in those fertilized with inorganic supplements for several years. Soil populations are more dependent upon complex interrelationships than upon single factors, such as moisture content of the soil, percent organic matter, and recent fertilizer applications. The Kjeldahl analysis demonstrated an increase in the amount of nitrogen incorporated in mutant cells of *Azotobacter chroococcum* over the amount incorporated in parent cells. The most promising results were achieved using 15-second ultraviolet light exposures. Soil analyses for organic and soluble nitrogen content were reported to area farmers. It is hoped that the data will aid them in evaluating their nitrogen usage last year and in estimating their needs for the coming year. A study of alternative methods to commercial inorganic fertilizers indicates that crop rotation and organic fertilizers significantly improve soil conditions and supplement nitrogen needs. The use of biologically active agricultural supplements, e.g., Agriserum and Erth-Rite, could also replace inorganic fertilizers.
Reference copy: Heidelberg College Library

****

Comparative Ecology of Native and Imported Fire Ants

(Grant no. GY-11444)

University of Texas at Austin
Austin, Texas 78712

June 1, 1974 - September 1, 1974

Participants:

Donald H. Feener
Sally C. Levings
Michael William Hooper
William E. Marshall*
Patricia A. Vogel

*Student Project Director

Lawrence E. Gilbert, Faculty Advisor

Six sites in East and Central Texas were surveyed to compare the ecology of communities containing the imported fire ant, *Solenopsis invicta* (Buren), with those communities containing the native fire ant, *S. geminata* (Forel). Baited ant trapping techniques were used to determine the arthropod composition of each site. Some of the relationships of the two species with the associated arthropods, in particular other ants, could then be deduced from the data collected in this manner.

An increase in the density of *S. invicta* was correlated with a decrease in diversity of ants coming to artificial food baits. In general, *S. invicta* takes relatively longer to find baits than do associated species, but are better recruiters, and eventually dominate baits through aggressive interactions. Ants which can locate and remove baits rapidly are capable of coexisting with *S. invicta*.

A trend of decreased ant diversity with increased *S. geminata* density was also observed but data were insufficient for any significance to be attributed to the regression.

A dendrogram of the various sites was developed by comparing amount, distribution and type of fauna collected in pitfall traps. Two major groupings could be distinguished.

The first group was mainly composed of *S. invicta* areas and characterized by much ground cover and litter, near pipelines and trails, high ant density and higher annual rainfall. The second group contained mostly *S. geminata* areas and is characterized by woods, overgrazed pastures or highway sides, not much ground cover or litter, lower ant density and lower annual rainfall. The sites with *S. invicta* had a higher density of arthropods than *S. geminata* areas. When the imported fire ant was removed, this density increased even more, indicating a significant effect by *S. invicta* on prey populations.

A drier than normal summer hampered study of *S. geminata* but also revealed different strategies of the two fire ant species. Drier weather and associated decreased productivity curtailed *S. geminata* foraging activity. In similar circumstances, *S. invicta* did not curtail foraging activity.

Reference copy: Biology Library, Patterson Laboratory, University of Texas at Austin

****

The Impact, Ecology, and Behavior of Feral Dogs on Fort Jackson

(Grant no. GY-11492)

University of South Carolina
Columbia, South Carolina 29208

May 22, 1974 - August 14, 1974

Participants:

Richard T. Boan
Vera Jean Fitzgerald*
Fook-Chi Lai
Philip Scott Moore
Charles Edward Proffitt
James Thomas Skeen

*Student Project Director

E. F. Thompson, Faculty Advisor

Feral dogs (Canis familiaris) in the Fort Jackson, South Carolina, reservation were studied in the summer of 1974, to discern their behaviors and general ecology. The dogs are usually small hunting breeds, often originally lost during local deer drives. The behavioral characteristics of these breeds make them particularly able to form packs without necessarily having the family unit nucleus which is the basis of many canid social systems. These breeds are also superior trackers, bred specifically as hunters and therefore have a high survival potential in the wild. They generally fill the niche of a top predator rather than a scavenger and low-level predator as reported in other areas. Fecal samples yielded white-tail deer (Odocileus virginianus), mole (Scalopus aquaticus), raccoon (Procyon lotor), cottontail rabbit (Sylvilagus floridanus), and human (Homo sapiens) hair. These dogs were found to be smaller than the red wolf (Canis niger), coyote (C. latrans), dingo, and the feral dogs studied by Scott in Alabama in every respect for which comparative data were available except jaw size. The packs varied in size from four to seven members, many of which were dogs originally under human control and not born in the wild. Truly feral dogs could be discerned by their aggressive behavior in the trap, while tame and pet dogs were docile and friendly. The tracks of the individual animals were distinctive, and this fact was used in working out the home ranges and activity patterns of the dogs. The home ranges of the two packs, calculated by the method of Haugen, were 2076.85 hectares and

1279.60 hectares. The packs shared no part of their ranges, and no individuals were known to have been associated with both packs. However, there were individuals that only sporadically ran with a pack. Included in the report are suggestions on a management policy for the fort. This included the requiring of all dogs used on drives within the fort to have identification tags, and a systematic fine requirement for returning lost animals.

Reference copy: University of South Carolina Science Library

****

Effects of Atmospheric Alteration on Vegetative Propagation, with Application to Timber Species (Grant no. GY-11521)

Oregon State University
Corvallis, Oregon 97331

June 17, 1974 - September 6, 1974

Susan Brown
John Burnett*
Stede Gahler
Russ Korvala
Mary Lundeen
Linda Park
Leslie Stout
Carolyn Wells
Larry Wolfe

*Student Project Director

William Ferrell, Faculty Advisor

This investigation was designed to demonstrate the influence of gaseous atmospheric constituents on the process of root initiation in vegetative propagation. Two factors, in addition to the role of various concentrations of CO_2, were tested to investigate their influence. They were:

A) importance of plant material - gas interface at the cut surface of the cutting; and

B) the influence of CO_2 on auxin-auxin degradation systems.

Before these two factors could be examined, it was necessary to demonstrate the role of CO_2 on rooting of plants. Misting chambers were designed and built so that various CO_2 concentrations could be introduced to the plant while maintaining a very high humidity to allow rooting. Native willow and poplar were the test plants used in the experiments. Gas concentrations from 0% CO_2 to 0.30% CO_2 were utilized. Maximum root populations (number of plants rooted per number of plants) for willow were attained at 0.13% CO_2. Normal atmospheric concentrations (0.03%) produced populations of 65% to 70% rooted. CO_2 concentrations elevated about four times (0.13%) produced 85% to 90% rooted populations.

For poplar, the results were opposite. The higher CO_2 concentrations (0.13%) were more detrimental than were normal conditions (0.03%), while rooting was improved as CO_2 concentrations approached 0%. This result indicated that the CO_2 influence on rooting may be species specific.

With the influence of CO_2 established, explanations of that influence could be initiated.

Gas uptake at the cut surface was tested by enclosing the tops of the cuttings in CO_2 impermeable bags and, thereby, separating the leaves and cut surface. Altering the CO_2 concentrations at both surfaces produced results confirming the supposition that the cut surface-gas interface was the more important of the two surfaces. When CO_2 concentrations at the leaves of 0.13% were employed, the results resembled those of the control chambers with rooting of about 70%

of the populations. When CO_2 concentrations at the cut surface of 0.13% were employed, the results resembled those of the experimental groups with rooting of about 90% of the population.

To understand the influence of CO_2 on the auxin degradation system, that system (indoleacetic acid oxidase) was extracted from plant material for in vitro studies. While these studies did show inhibition of the oxidase system, that inhibition could be due to a number of factors beyond a classical enzymatic inhibition condition.

Combining these two factors with the overall finding on the influence of CO_2 on propagation demonstrates that atmospherically controlled growth chambers will provide new understanding of the processes of root initiation.

Reference copy: Kerr Memorial Library, Oregon State University

* * *

Prairie Restoration Experiment in Ohio (Grant no. GY-11520)

Miami University
Oxford, Ohio 45056

June 10, 1974 - August 31, 1974

Participants:

Janissa Balcomb
Larry Bright
Dorothy Carman
Earl Crosby
Jay Leibovitz*
Linda Leigh
Michael McMullen
Neil Mullane
Ann Randall
Patricia Shellhammer

*Student Project Director

Roger E. Wilson, Faculty Advisor

There is much evidence to demonstrate the historical presence of tall grass prairie in Ohio. As to how it got here, there is much controversy. Some say prairie species migrated to Ohio in pre-glacial time; others say the prairie is a phenomenon which followed the glaciers, However, the early settlers in Ohio encountered the tall grass prairie and for the most part, avoided it. Basing their geographical/ agricultural expansion on their experience in the East, settlers believed that land that did not grow trees was not useful as cropland. In the 1840's, with the help of the newly-acquired mould-board iron plow, and with the need for late-coming settlers in some areas to begin moving on to and farming "marginal" areas, the newcomers of European ancestry realized the tremendous fertility of prairie areas. This set the stage for a more rapid expansion westward to begin farming the prairies, and the almost complete destruction of the Ohio prairies due to agricultural exploitation.

Presently, prairie remnants in Ohio exist for the most part in relatively inaccessible areas (e.g., clifftops or steep moraines), or in protected areas (e.g., private land or nature preserves). These relict areas are therefore usually small and fragile, and restricted use is essential for their survival.

The members of our project perceived a need for the further restoration of accessible, usable prairie areas in Ohio. To determine methods for doing this, we picked as our location for the project Butler County in southwestern Ohio. Butler County has an historical basis for prairie restoration, having been documented as being one-sixth (1/6) to one-fifth (1/5) grassland by the early settlers.

Four test sites of one acre each were all located within an eight mile radius of Oxford, Ohio. Each of these sites was prepared so as to represent one-half acre "hard" (mean = 1.19 g/ml) seedbed preparation, and one-half acre "soft" (mean = .87 g/ml) seedbed preparation. (This difference was significantly different at the .01 level of confidence). These half-acres were then again divided into halves, with each quarter-acre quadrant (by compaction) being planted with either northern or southern varieties of five native grass species: Andropogon gerardi (Big Bluestem) Andropogon scoparius (Little Bluestem); Boutelous curtipenduta (Side-oats Grama); Panicum virgatum (Switch Grass); and Sorghastrum nutans (Indian Grass). A sixth species, Phalaris arundinacea (Reed County Grass) was also planted, although only one variety was used. These six grasses represent native species found in areas representative of wet to dry climatic conditions, and short grass to tall grass prairie habitats.

During the course of the study, extensive analyses were made on the physical, chemical, and nutrient properties of the soils at the plot location including average pH; base exchange; total organic carbon; phosphorus; calcium; magnesium; and total nitrogen. Also, ancillary measurements were taken to characterize weekly averages of maximum-minimum temperatures, rainfall, and available soil moisture.

During the eleventh week of the study, aerial biomasses of the vegetation in randomly distributed meter-square quadrants were measured using the harvest method for each of the seedbed firmness/species variety subplots.

At the end of the first summer, the measureable aerial biomass of the planted prairie grasses was minimal. This is due to the fact that an extensive percentage (estimates of 65% to 80%) of the net primary production of grasslands goes into underground (root) growth. Studies of root biomass were not undertaken.

It is important to note the types of invading weedy species on the test plots during this first year. These species reflected an extremely high percentage of annuals, which will eliminate themselves from the plot in the regular course of succession. The small amount of perennials present will affect only minimally the continuing growth of the native grasses. Therefore, increased evidence of aerial production of the grasses will be noticeable in coming years.

After sampling, coefficients of similarity were determined for within and among plots according to hard and soft seedbed preparations and among plots by the total communities. The mean of the within plot comparisons of hard and soft seedbed treatments (72%) represents the degree to which the surrounding vegetation or dormant viable seeds in the soil at each site were responsible for weed invasion. The means for the among plot comparisons of hard seedbed treatments (28%) and soft seedbed treatments (31%) represent the degree to which seedbed preparation controlled the invasion of weedy species. As the first of these three means is greater than the latter two, it can be concluded that the surrounding seed source or dormant viable seed in the disturbed ground at a planting site carries more weight than hard or soft seedbed preparation with regard to controlling invasion of weedy species during the first growing season.

Although the growth of the native grasses was minimal, it is still possible to make some preliminary, although not statistically measureable, observations. The "hard" seedbed treatments yielded more above ground (shoot) growth (aerial biomass) of native grasses than the "soft" seedbed treatments on all four test plots. Our project has initiated a range of compactions to begin clarifying the term "hard seedbed" as proposed by other researchers and agronomists.

Plots 3 and 4, which demonstrated the greatest difference between the hard and soft seedbed preparations also exhibited the highest total growth of native prairie grasses. This is paralleled by the fact that these two plots contained the highest diversity according to biomass of invading weedy species, as compared with plots 1 and 2, which were invaded and dominated by single robust species.

We believe it is essential to take into account the characterization of the site's surrounding community and viable dormant seeds in the soil as a potential source for weed invasion as a first-year phenomenon in planning to establish or restore native grasses to Ohio. Further research is needed on this hypothesis for first year data, as well as to see if this continues to be a factor in successive years. A need to test phytotoxicity, the phenomenon of toxins of one plant (e.g., Setaria sp. or Ambrosia trifida) acting against the success of another plant species in that habitat (e.g., newly planted prairie grasses) has also been indicated.

Reference copy: King Library, Miami University

****

Population and Habitat of the American Alligator (An Endangered Species) in Texas (Grant no. GY-11523)

Sam Houston State University
Huntsville, Texas 77430

May 20, 1974 - August 10, 1974

Participants:

Gregory E. Crouch*
Mary Kay Crouch
Reid L. Dennis
Claire Guyton
Richard A. Hilliard
H. Earle Janssen, Jr.
Gayle Michelson
Jimmy L. Tipton
Rudolph P. Zalesak

*Student Project Director

Non-Stipend Participants:

Lee A. Fitzgerald
Cynthia Jefferson
James Mathis
Brad Townsend

James R. DeShaw, Faculty Advisor

This study covered the eastern portion of Texas. Seven counties were selected which were representative of the diverse habitats in which alligators are found. The objective of the study was to compile and analyze data on the vegetational, climatic, populational, aquatic quality, and societal impact of the alligators' environment on this reptile.

The zoologists working in conjunction with the Texas Parks and Wildlife Rare and Endangered Species Division, made an evaluation of the alligator population in Texas. This was undertaken by two methods. A questionnaire compiled by this group and Mr. Floyd Potter, Wildlife Biologist for the Texas Parks and Wildlife Department, was mailed to game wardens, wildlife biologists, and other State personnel on a county by county basis. "Night lines" were also run by members of this group and personnel of the Texas Parks and Wildlife Department throughout the State. It was discovered that there are approximately 36,000 alligators in Texas, in an area that traverses 97 counties.

The members of the botany group characterized the habitat of the American alligator with respect to vegetation. Each location visited was analyzed for three vegetational types: terrestrial vascular plants, aquatic vascular plants, and phytoplankton. Data from each site was computed for species diversity, index of similarity, and importance value by utilizing the facilities of the Sam Houston State University Computer Center. The two sites sampled that contained the largest alligator populations: Fort Bend County--Smither's Lake and Montgomery County--Grand Lake, were found to have relatively high diversity per individual values for herbaceous plants. These two sites have in common a large number of grasses, semi-aquatic herbaceous plants and trees. The sites with smaller populations lacked these characteristics.

The highest concentration of alligators occurs in the upper coastal prairie, which exhibits tall grasses, traversed by timber and bordered by coastal marshes. The general distribution of the alligator follows the boundary of the Oak-Hickory region.

The major objectives of the environmental section were to make a general survey of the aquatic quality of the habitat of the American alligator, and to determine the levels, if any, of pesticide residues in the organisms of the alligator's food web. Analyses of the water samples from each location consisted of testing for transparency, dissolved oxygen, conductance, temperature, coliform, turbidity, nitrate, total phosphate, total hardness, calcium hardness, magnesium hardness, chloride, pH, iron and sulfate. An analysis was conducted of pesticides, including PCB, mirex, chlordane, endrin, heptochlor epoxide, BHC, DDD, DDE, DDT, and Dieldrin. It was surmised that all of the sites sampled were relatively free of potentially toxic levels of organopesticides. There appears to be a direct relation between land use and pesticide residues in snakes. It was also concluded that in the sites tested there was no high waste load level, and all the sites, with the exception of Smither's Lake, had a natural water quality with little indication of man-made pollution.

The objective of the meteorology section was to examine the relationship between the range and population density of the American alligator in Texas, and climatic and geographic characteristics of the State.

The range limits of the alligator in Texas seem to be defined on the north by the isotherm of January average daily minimum temperature of 35°F. To the south and west, the range appears limited by the lack of available habitat because of low rainfall and high evaporation.

A significant correlation exists in the East Texas area between average January temperature and the logarithm of the population density, defined as number of alligators per square mile of habitat. This is probably related to the increased activity of alligators at warmer temperatures, which would increase their chances for survival in warmer areas in winter. The low number of alligators per square mile of habitat in the South Plains area of Texas may be related to the high evaporation and low rainfall in this area, which may make aquatic habitat undependable from year to year.

The aim of the sociology group was to determine the attitudes and opinions of the residents in the study area about the American alligator. A questionnaire was devised which could be presented orally to residents at randomly selected residences throughout the counties that were studied. One person of every 725 was interviewd throughout the seven-county area. Compilation and analyses of this group's data revealed several interesting correlations. It was found that 71% of the residents considered the alligator to be dangerous, while 65% had never heard of anyone being injured by an alligator. Of these residents, 61% realized the alligator is considered to be an endangered species and 66% were against its possible extinction, but when faced with the question of allowing the alligator population in their county to increase, only 36% were agreeable. Of those interviewed, 79% were unaware of the laws protecting alligators

Reference copy: Sam Houston State University Library

****

Analysis of Aerosolized Pollutants in Feedlots and Other Environments (Grant no. GY-11472)

University of Northern Colorado
Greeley, Colorado 80631

June 10, 1974 - August 16, 1974

Participants:

Susan Detmering
Harold Gilbert
Arlyn Ristau*
John Seaberg
Mary Sinsel
Shelley Watts
Cynthia Whitelaw
Norene Van Oort

*Student Project Director

Bert D. Thorpe, Faculty Advisor

The community of Greeley, Colorado is situated in a unique environmental setting in the heart of the cattle-feeding industry of northeastern Colorado. The cattle feedlots have been subjected to much criticism both from an aesthetic and a health standpoint. Therefore, it was desirable to investigate any possible environmental contamination by the feedlots in order to provide information for the protection of the community, as well as for the feedlots.

The specific factors considered in this study were aerosolized microorganisms (bacteria and fungi) and aerosolized particulate matter (fecal material, feed-dust, pollen and spores). These aerosols may directly affect the health of the human and animal populations of the community by direct transmittance of infection, acting as irritants enhancing the frequency of upper respiratory infections, and causing the development or enhancement of existing allergic conditions.

Airborne bacteria and fungi were collected using an Anderson-Cascade air sampler and a membrane filter sampling device. Sampling sites were established at the Ross Hall of Science and at positions one mile upwind and downwind from two large cattle feedlots on the edge of the city. The feedlots selected differed in area, size of herd populations and practice of dust control measures. Bacteria and fungi obtained by air sampling were counted, described and representative organisms were selected for further identification.

Airborne particulate matter was collected using static dust samplers located at the Ross Hall of Science and on the edge of one of the feedlots. Samples were qualitatively analyzed and identified by microscopy using an atlas of particulate identification. Meterological conditions were monitored daily to determine any influence which weather conditions might have on both the airborne microorganisms and particulate matter.

Elevated numbers of airborne bacteria were observed at feedlot sample sites. The numbers of bacteria detected downwind were usually greater than detected upwind. Elevated counts were observed in the city when the wind direction was such that the city was downwind of the feedlots. Analysis of the bacterial types present in the air revealed that the predominant organisms were typically soil-inhabiting, spore-forming species of the genus Bacillus. The remainder were other gram-positive organisms of the genera Corynebacterium, Arthrobacter, Staphylococcus, Gaffkya, Micrococcus and Sarcina. The Actinomycetes and other miscellaneous forms were less frequently observed. Few gram-negative bacilli or coliforms were present.

Patterns for airborne fungi were somewhat different from those of the bacteria. While counts generally were greater downwind and upwind from the feedlots, counts did not increase significantly when compared to counts obtained within the city. This would suggest other factors in the surrounding environment also having a role in airborne microbial populations. The predominant fungi in the air belonged to the genera Alternaria, Aspergillus, Fusarium, Aureobasidium, Cladosporium, Paecilomyces, Penicillium, Rhizopus, and Verticillium.

Airborne particulate matter identified from the air consisted of manure, various spores, pollen, feed and grain dust, diatoms and hair, as well as other materials which were not identifiable. The presence of minute manure particles in air samples within the city would support the premise that the manure does dry up and can be readily suspended by wind and air currents, eventually becoming dispersed some distance away from its source.

The possible effect of the airborne microorganisms and particulate matter on the health of the residents of the Greeley area was not ascertained. None of the organisms identified could be directly implicated as a respiratory pathogen, but some might act as opportunistic pathogens if circumstances permit invasion of the respiratory system. The potential for the development of allergies in individuals to these aerosols would seem possible.

Reference copy: Michener Library, University of Northern Colorado

****

Range Rehabilitation in the Midway Watershed Area (Grant no. GY-11488)

New Mexico Institute of Mining and Technology
Socorro, New Mexico 87801

Summer 1974

Participants:

Brenda F. Anderson	Geza Keller
Steve N. Dixon	Victoria Kittrell
David Elsbernd	Karen Putzig
Paul Fleissner*	Karl Reineke

Jerry Scott

*Student Project Director

Non-Stipend Participant:

Sally Haigler

Clay T. Smith, Faculty Advisor

The Midway Watershed Area is located about five miles north of Socorro, New Mexico on the west side of the Rio

Grande River. The sites for the research project are included within 1200 acres of upland, foothill, and mountain land. Sparse vegetation affords poor grazing for the area's ranching industry, a principal source of livelihood in this part of the State. Frequently, intense summer thunderstorms produce excessive runoff from these areas, causing flood damage to structures and irrigation systems in the river valley.

The purpose of this study was to continue the monitoring of vegetative changes induced by clearing and seeding operations started in 1972 and 1973. In 1972 Site One and Two were established and seeded. Using 1972 data, Sites Three and One Prime were founded. Sites Two and Three are located in creosote bush areas, while Sites One and One Prime are situated in non-creosote lands. Each site is divided into twenty to thirty-two plots of 2500 square feet each. Randomly selected plots in each site are retained undisturbed as controls while the remainder are cleared and seeded. The majority of seed plots had mulches added. Mulches composed of fly ash, treated sewage sludge, straw, and bark chips, singly and in combination were added to the soils. Heavy growths of grasses have occurred on the treated plots of Sites One, One Prime, and Three. The organic mulches produced more growth than did fly ash mulches. Site Two continues to have poor plant growth, primarily due to the high calcium of caliche soils. Especially on Site One, natural reseeding is progressing at a good rate, even into grazed, uncleared areas.

Chemical analysis of soils in the test area show little difference in inorganic and trace metal nutrient levels between creosote and non-creosote areas. Microbiological studies of creosote soils show a lowered rhizophere effect around the creosote bush roots. Since microbes moderate many scil reactions, this lack of microbes may be important in total soil fertility. Additional factors in the creosote soils caused seedling death in test plants.

Microclimate differences were found to occur between the test sites. In all cases the creosote bush areas experienced between 15%-20% less rainfall than the other sites experienced. Though the data is not conclusive, the information afforded shows that the creosote occupies areas of least rainfall and perhaps modifies the local atmosphere enough to lower local precipitation Soil temperature and moisture studies showed no diurnal variation that would affect the balance of plant cover.

Reference copy: Library of the New Mexico Institute of Mining and Technology

****

An Ecological Inventory of Devil's Den State Park (Grant no. GY-11455)

University of Arkansas
Fayetteville, Arkansas 72701

May 27, 1974 - August 17, 1974

Participants:

May Berenbaum	Paul Kuroda
Jay W. Custer	Mark J. Lockerd

Thomas P. Ducker
Elizabeth Gaines
Susan L. Huckleberry
*Student Project Director

Janice Placke*
Thomas M. Rolniak
Rose A. Scruggs

Non-Stipend Participant:
Jeffrey Short

Edward E. Dale, Faculty Advisor

Devil's Den State Park is located eight miles south of Fayetteville, on U. S. 71 and eighteen miles west on State Highway 170. The Park encompasses approximately 2,250 acres within the confines of the Ozark National Forest, and consists of undeveloped wild forest obliquely cut by Lee Creek, a tributary of the Arkansas River.

According to Arkansas State Highway Department plans for District 9 a four-lane limited access expressway contract was scheduled for letting during the fiscal year 1974. Though no exact route was defined, three alternate corridors were selected: the closest coming within a mile of Devil's Den State Park and the furthest sweeping within six miles of the park. Because of the tremendous construction costs involved in building over this mountainous terrain, the Highway Department unofficially acknowledge the possibility of the expressway passing directly through the park in the Lee Creek Valley.

This study attempted to conduct an in-depth ecological inventory of the park area. This report is not intended to be an impact statement, but rather attempts to provide necessary baseline data and an understanding of the natural processes controlling the park's various environments; thus providing a basis from which later impact statements or evaluation reports might draw.

Reference copy: University of Arkansas Library

****

Anasazi Prehistory, Public Lands and Blanding, Utah: A Research Design for Symbiosis (Grant no. GY-11419)

Brigham Young University
Provo, Utah 84601

April 29, 1974 - June 20, 1974

Participants:

James Dykman	Glen Nebeker
Kathryn Hurst	Glenna Nielson
Winston Hurst	James Thompson
Bruce D. Louthan*	J. Terry Walker
Blain Miller	Pamela Wilder

*Student Project Director

Dale L. Berge, Faculty Advisor

Recent archaeological surveys done by faculty and students of Brigham Young University for the U.S. Forest Service have discovered numerous Anasazi sites well over 6,500 feet above sea level in areas previously very little known archaeologically. At Milk Ranch Point in the Manti-LaSal National Forest near Blanding, Utah, 687 sites ranging from the Basketmaker II through the Pueblo III period are contained in an area approximately 4½ miles square. Why the Anasazi settled in this vicinity, especially the Pueblo I concentration; what resources attracted them; what was the subsistence base in this mountainous terrain; and what are the precise characteristics of the local cultural manifestations are key questions only answerable through a rigorous program of archaeological excavation, botanical and palynological sampling, and extensive analysis. Comparison with regional Anasazi manifestations will provide a broader understanding of the significance of the Milk Ranch Point area in relation to this region. Such a project of excavation, botanical and palynological sampling and analysis was undertaken by the SOS team.

Data thus gathered will have importance in three ways. First, it will broaden our understanding of the range of subsistence patterns employed by the Anasazi and establish a firm chronological and typological framework in this particular area. Second it will provide the Forest Service personnel charged with management of the "non-renewable resource" (archaeological sites) with a basis for critical decisions on salvage work needed before imminent land development for livestock grazing, uranium (and other) mining or oil drilling is allowed. Finally, a multidisciplinary project will also provide much needed data on the Anasazi lifeway for a planned museum in Blanding, in addition to better familiarizing the interested local population with the aims of modern archaeological research in an effort to reduce the vandalism of ancient sites now so prevalent.

Reference copy: Library, Brigham Young University

****

Desert Land Use and Management in California--Its Ecological and Sociological Consequences (Grant no. GY-11425)

University of California at Irvine
Irvine, California 92664

June 1, 1974 - September 1, 1974

Participants:

Richard F. Ambrose	Kenneth Q. Lindahl, Jr.
Gail A. Baker	Philip R. Martz
Nathan J. Cole	John Pinelli
Russell O. Davis*	Ann G. Rappoport
James H. Graham, Jr.	Jerry L. Reynolds
Peter M. Kareiva	Johanna M. Schmitt

Janet L. Wheeler

*Student Project Director

Keith E. Justice, Faculty Advisor

This project was an interdisciplinary and multivariate systems approach to a study of the desert environment (Joshua Tree National Monument, California). The research comprised both the societal components of land use and the environmental impacts of desert land use. The impetus for this study was the California Bureau of Land Management's controversial plan for regulating use of the State's twelve million acres of publicly owned desert lands. It was clear that this plan suffered from the lack of scientific data which could quantify the impact of different use levels on the desert ecosystem.

The sociological focus evaluated use-pressure, economic ramifications of desert management, and positions and causes leading to the polarization between "existing use" and "preservation".

Ecological research was directed towards the analysis and comparison of two desert situations--pristine and moderately used. Numerous physical factors, directly and indirectly associated with land use, were measured in these two areas. Biological surveys of plants and animals were undertaken with concern especially for the "natural" community level of organization (species diversity, trophic interactions, etc.). Permanent transects were established and base-line data collected for use in future research. After multivariate analysis, correlations between land use, physical factors, and biological factors, a model was established, tested, and re-evaluated in a third, heavily used and "abused" desert location.

Reference copy: Library, University of California at Irvine

****

Management of Wastes Created by Removing SO_2 from Industrial Discharges (Grant no. GY-11448)

Bellarmine College
Louisville, Kentucky 40205

May 20, 1974 - July 20, 1974

Participants:

Steve A. Blanton	Arthur L. Stead
David W. Hammer	George M. Taurman III
Daniel M. Magera	Robert A. Todd
Joseph R. Mattingly, Jr.	Mark Vissman
Robert B. Palmer-Ball	Vanessa Wethington

Robert Young*

*Student Project Director

John M. Daly, Faculty Advisor

In Louisville there exists a potential hazard which may become a major problem in the future. In scrubbing the sulfur dioxide from its stacks, the Louisville Gas and Electric Company is producing huge quantities of calcium sulfite. At present, a single 50 megawatt unit produces over 20 tons of this waste a day. Plans call for these scrubbers to be placed on 1500 and 200 megawatt units. This large amount of waste is being piled at present and could, some day, present a dangerous problem.

This SOS team sought practical applications for the waste product so that it could be converted into a useful material. The group was divided into several sections to pursue such applications. The Materials Section investigated structural applications of the material produced by the SO_2 elimination system, including the production of wallboard, concrete additives, paint fillers, and a plaster material. The Analysis Section performed a detailed chemical analysis of the material produced by the sulfur dioxide elimination system. Another group studied the presence of bacteria in this industrial discharge and sought to identify the various organisms. Finally, a project section mixed strip mine soil with the SO_2 waste to determine optimum soil conditions for plant growth.

Reference copy: Library of Bellarmine College

****

Ecoarcheological Investigations in the Sonoran Biome of Western Nevada (Grant no. GY-11483)

California State College at Stanislaus
Turlock, California 95380

June 3, 1974 - August 26, 1974

Participants:

Charles D. Bartsch	Marlene Milosevich
David M. Flint	Joe Pope*
Jeanne D. Gillen	Charles F. Welling
James G. Gude	Hidekazu Yamashita
Thomas K. Hall	Paula A. Whittier

*Student Project Director

Lewis K. Napton, Faculty Advisor

Our SOS group investigated the ecoarcheology of a prehistoric occupation site in Eastgate Canyon, Nevada, located about fifty miles southeast of Fallon. The investigations were designed to reveal the structure and function of human adaptation in Sonoran biomes in both prehistoric and historic times. The prehistoric data was produced by archeological excavations in a large rockershelter site, and the data pertaining to historic occupation and land use was derived from ecological, biological, zoological, and geographical studies of the extant flora and fauna in relation to the physical environment.

The final report gives findings for the geography, history, botany, fauna, and archeology of the area. These findings support the hypothesis that man settled in the Eastgate area ca. 3000 to 4000 years B.P. The latter date is some three thousand years earlier than investigators had previously postulated for this area.

Reference copy: Library, California State College at Stanislaus

****

Section III.

Urban and Rural Studies

Papers from Brown University, University of California at Santa Barbara (2), University of North Carolina at Chapel Hill, University of Virginia (2), University of Washington, Newark College of Engineering, New Mexico Institute of Mining and Technology, University of Northern Iowa, SUNY-State University at Buffalo (2), California State University at Sacramento, Florida Technological University, University of California at Riverside, Colorado College, New Hampshire College, University of Colorado at Denver, Northern Arizona University, University of California at San Diego, CUNY - Lehman College, Marlboro College, Columbus College, University of Wisconsin at Green Bay, University of Hawaii, College of Idaho, Harvey Mudd College, Pennsylvania State University, University of Missouri at Kansas City, Temple University, University of Oklahoma, Michigan State University, Thomas More College, Northern Illinois University, SUNY - State University at Stony Brook, University of Oregon, Western Washington State College, and Wesleyan University.

Neighborhood Resistance to Group Home Establishment in Rhode Island (Grant no. GY-11435)

Brown University
Providence, Rhode Island 02912

June 3, 1974 - August 23, 1974

Participants:

Mark Feragne
Martha L. Jones*
Gene Karpinski
Annmarie Levins
Sally Mac
Claudia Strauss
Janet Walden
Kenneth Warren

*Student Project Director

Ernest B. Attah, Faculty Advisor

Group homes are "community-based" homes, supervised by resident staff, which provide a living place for children who cannot live with their own families. Each home is usually designed to meet the needs of a specific group of residents, such as the retarded, juveniles who have been in trouble with the law, emotionally disturbed or neglected/dependent youngsters. The term "group home" is used to describe a house that looks no different than the other houses on the block, where four to 12 young people live using the schools, recreation programs, counseling, and medical facilities in the community.

In the past few years officials across the country have turned to group homes as one hope for successfully and more efficiently treating troubled youths. However, those setting up group homes often encounter community resistance to such facilities. It is to this problem of resistance--any actions taken by local residents against a group home which seriously threaten or actually prevent its establishment--that this study was addressed.

The goals of the project were: (1) to examine why resistance varied from one establishment attempt to another; (2) to predict the likelihood of resistance in future attempts to establish group homes; and (3) to formulate a set of optimal procedures for avoiding resistance. To meet these goals, investigations were made of 14 attempts to establish group homes for neglected/dependent, wayward/delinquent, or emotionally disturbed young people between the ages of six and 18 in Rhode Island. Specifically, data were gathered about the characteristics of the homes and the strategies used in their establishment attempts and about the physical, social, and political characteristics of the neighborhoods where group homes were proposed.

Data on the above variables came from documents, interviews, surveys, and the 1970 census. The documents included newspaper articles, records of public meetings, and records of the homes and their sponsoring agencies. Standardized interviews were conducted with organizers, staff, and others working for each home, as well as with persons who supported or opposed a home, local officials involved in an establishment attempt, and State officials in charge of licensing and administration of group homes. A community attitude survey developed from several published attitude scales and a group home attitude scale devised by the group were administered to a 10% random sample of the block group for each home. Census information for the areas was extracted from Count 5 census tapes.

Analysis of the data revealed that certain types of neighborhoods are likely to resist group home establishment.

Residents of such neighborhoods were married persons who had lived in the area for more than five years, owned their houses and two automobiles, felt the community was peaceful and orderly, had children of their own, and were middle-aged. Such individuals have a "stake" in their community and are likely to feel threatened by the possibility of a group home that might disrupt their neighborhood.

However, demographic characteristics did not explain all variations in group home resistance. It was found that, in general, a group home establishment will be resisted if community members know about the attempt, have a negative image of the home, and feel they can seriously challenge its ability to become established.

Usually, knowledge of the home is dependent on the approach used in establishing the home and the type of neighborhood in which the home is proposed. Three types of approaches were delineated: the "sneak" approach in which neighborhood residents are not told about the establishment attempt, the limited publicity approach in which a number of residents of the immediate area of the home are personally informed by group home organizers, and the community education approach in which a mass media campaign explains the group home to the community at large. The optimal approach to minimize resistance depends on the type of neighborhood (specifically, on the amount of interaction among residents, the stable residency of the population, and the concern and attachment residents have for the area). Whether residents know about a home is also influenced by the physical characteristics of the specific site--

the greater the "buffer zone" (property used for something other than private residence) around the home, the less likely it is that neighbors will know of the activities concerning the home.

Another important factor related to resistance is the image the neighbors have of the group home. If the home can present an image of competence and great concern for the neighborhood, the fears of neighbors that the area will be disrupted are lessened and resistance can be avoided. Organizers can display concern for the area by obeying community norms, presenting honestly the plans and program of the home, accepting responsibility for any problems caused by the home's residents, and allowing community members a voice in decisions concerning the home through positions on the home's board.

Finally, community members are likely to object to a home if given the chance through a public meeting or zoning hearing. To avoid resistance, group home organizers should be wary of such situations.

Through careful planning and consideration of these important factors, it is hoped that group homes can more successfully avoid resistance in the establishment process.

Reference copy: John D. Rockefeller, Jr., Library, Brown University

****

The Crosslanguage Intelligibility of Phonemes, Sources of Interference in International Voice Communication (Grant no. GY-11468)

University of California at Santa Barbara
Santa Barbara, California 93106

June 17, 1974 - August 23, 1974

Participants:

Janice Linda Bedrosian	Patricia Maurine Lindsay*
Bernard Dominique Brousse	Randolph Eugene Paige
Monika Toni Oeste Johansson	Rene Gonzales Rodriguez

*Student Project Director

René Malécot, Faculty Advisor

The efficiency of crosslanguage voice communication is affected by phonetic factors and by the acoustic characteristics of the transmission medium used. This becomes vital in situations such as air-traffic control, where pilots of foreign aircraft are receiving directives and exchanging information with American ground personnel, and vice versa. This study limits itself to the phonetic aspects of the question, in three arbitrarily chosen transmission conditions (restricted bandwidth, white noise background and babbling voice background). Context is eliminated from consideration by the use of nonsense test items, and the study is limited to voice communication in American English in situations where the phonemes of that language are uttered by American speakers and identified by speakers of French, German and Mexican-Spanish, and vice versa. These limits are predicated on the fact that English is used in air traffic control in the majority of the world's international airports. Finally, the study is limited to consonants, to keep the research within feasible proportions, and because the functional load of vowel differentiation in English is relatively small, given the neutralization of unaccented vowels.

The methods used in the study involve the analysis of the judgements by groups of phonetically naive listeners of the four nationalities, as they attempt to identify American English consonants in nonsense syllables, recorded by speakers of languages that are not their own. The consonants occur in initial and terminal positions in monosyllabic items and intervocalically in disyllabic items. Each consonant-times-position is repeated with front, central and back vowels to determine if these affect the perception of the consonants. All the phonetic conditions noted above are repeated in each of three transmission conditions: The first is free of extraneous background but restricted to a bandwidth of approximately 300 to 3000 Hz. The second adds a background of white noise, the third a background of a number of voices talking simultaneously in several languages. The judgements are tabulated and analyzed statistically, and from these numerical results, analyses of the areas of interference are made and appropriate conclusions and recommendations drawn.

A native speaker of a standard dialect of each of the languages recorded the stimuli. They were all language specialists and were, thus, phonetically knowledgeable. They uttered the items in an American English linguistic frame of reference but in the phonetic frame of reference of their native tongues. A degree of influence from the spelling of the items was assumed, corresponding to observed habits of people of the nationalities involved with the social background and degree of education from which pilots and air-traffic control personnel are recruited.

Sixty subjects were used as listeners. Of these, 30 were Americans, 10 French, 10 German, and 10 native speakers of Mexican-Spanish. Criteria for selection were age (18 to 50 years) and normal hearing. Each American listened to the tape-recorded language to which he or she had no previous exposure, and each subject was required to attend two half-hour testing sessions, with a one day interval between the two.

The numerical data are rich in information pertaining to the cross-language intelligibility of phonemes, as it is affected by the various contextual and technical factors involved. Vowel context, for example, differentially affects the perception of certain consonants in certain positions in the utterance. White noise is more likely to affect the perception of fricatives than of other classes of consonants. The stops in final position were by far the most difficult phonemes to identify for all listeners, especially for those whose native language was other than English. The next troublesome group of phonemes were the nasals, and the fricatives in initial and final positions. The latter were correctly identified about half the time. The rest of the classes of phonemes was marginally perceived except for the stops in initial and medial positions. They were correctly identified on an average of at least 80% of the time.

As expected, consonants in intervocalic position were more readily identified than in the other two positions due to the greater information communicated to listeners in terms of formants preceding and following the consonants in question. The average correct responses for all languages combined for all stimuli was 70% for intervocalic position, 64% for initial position and 49% for final position. That is to say, of all the consonants heard in intervocalic position (all vowels and all conditions), 30% were not identified correctly; in initial position, more than half were misunderstood. Taking an average of all three positions, the one figure that summarizes all tests given for all accents is 61%. This means that 39% of the stimuli were not intelligible to 60 participants listening to French, German and Mexican-Spanish accents in English. This is quite significant in helping us to understand, at least in part, why crosslanguage communications problems exist. It is evident that if over a third of the information carrying elements of speech are missing, faulty communication will necessarily occur. As far as the effect of the background conditions are concerned, the stimuli most difficult to identify were in noise and babbling voice backgrounds in terminal position, where stimuli were incorrectly identified more than half the time. The rest of the time, the average response was marginal, with a number of listeners responding well with some accents.

The results of this study and others of its kind should form the basis for revising the procedural jargon used in air-traffic control and similar situations by avoiding key words that have the critical phoneme plus phonetic context characteristics described above. In addition, phonetic identification aptitude tests should be used for screening key personnel and appropriate training should be used.

Reference copy: Library and Phonetics Research Facility, University of California at Santa Barbara.

****

North Carolina's Governmental Response to the Energy Crisis

(Grant no. GY-11475)

University of North Carolina at Chapel Hill
Chapel Hill, North Carolina 27514

May 20, 1974 - August 9, 1974

Participants:

Stephen Allred
Martha T. Bowles
William Gormely
William Kaempfer
Michael J. Karpinski
Alfred R. Light*
Robert Navazio
James Penny
Robert Pierce
Elizabeth R. Saslow
Rose Spalding
Mary Catherine Stack

*Student Project Director

Thad L. Beyle, Faculty Advisor

This project was an interdisciplinary approach to the study of the formulation and evolution of energy policy in the state of North Carolina during the winter of 1973-74. It systematically describes the impact of energy shortages on the State and the various governmental responses to them during this period. Methods of investigation included the analysis of a 4-wave panel survey of public opinion on the energy crisis, content analysis of North Carolina newspaper stories and editorials, personal interviews with State legislators, administrators, local government officials, and Federal officials involved in energy policy-making and administration in the Tar Heel state, a survey of gasoline station operators, and analysis of energy and economic indicators within the state.

The project reached the following conclusions.

1. Practically nothing in the way of coherent or integrated energy contigency planning was done before the 1973-74 energy crisis occurred. Instead, some State agencies on their own tried various approaches to energy planning.

2. This fragmentation of decision-making persisted to a large extent throughout the "Embargo Period." Only the fortunate happenstance that an "energy study" panel had been created in the spring of 1973 gave North Carolina a mechanism to handle the State role in the Federal emergency fuel allocations program.

3. The eventual creation of the State Energy Division in the North Carolina Department of Military and Veterans' Affairs was the minimal response required by the Federal government. This organization lacks the tools to do an effective job either in allocations or in research conservation.

4. As administrative agencies and local governments felt the squeeze of gasoline and other petroleum shortages, they responded in defense against distortion of their activities. Local government officials, reacting in the absence of coherent Federal or State energy policies to fuel shortages, in some cases developed a fuel shortage early warning system in conjunction with local gas station operators. Operating in isolation from one another, i.e., with little coordination with other cities or assistance from the State or Federal government, city governments did institute some energy conservation measures and did construct some contingency plans.

5. The Federal allocations process was often disorganized and incoherent to State officials, local officials, suppliers, citizens, and to many Federal bureaucrats themselves. Contacts among Washington and Atlanta-based FEO officials and State energy persons were spasmodic and unpredictable. Such intergovernmental incoherence persists despite FEA's creation as a separate Federal agency.

6. State and local officials, as well as ordinary citizens, blame the oil companies, above everything for the winter energy shortages. This view is coupled with a belief that the energy problem may be beyond man's control These attitudes are associated with the notion that there is very little "we" can do about energy problems.

7. Economists, industrial engineers, and other scientists advise various State energy policymakers about programs of energy legislation, administration, and regulation. Such contacts are handled on an informal person-to-person and telephone basis. In energy policy, the advice which mattered did not come through any formal university agency which is supposed to provide consulting and research services for State and local government.

8. Research on energy budgets and the North Carolina economy during the crisis period was conducted through the State planning office and the Research Triangle Institute, a private contractor. Those in charge of fuel allocations programs did not interact frequently with the research-planner network. The "energy research and planning" subsystem was quite separate

and distinct from the "allocations and energy crisis management" subsystem.

9. No one collected statewide energy use data on a regular basis. Energy supply data collection was also haphazard. Washington, Atlanta, and Raleigh officials all mistakenly thought others had such data. No one did.

10. Newspapers in North Carolina, because they are read frequently by North Carolina political elites, have the potential to assist in setting goals and agendas for policymakers. Editorials as they were written, however, could not have aided the State in setting appropriate energy policy and did not.

11. Partisan and constitutional politics shaped governmental responses to the energy crisis in unfortunate ways. The North Carolina ligislature's traditional distrust of the executive was critical in the defeat of an energy emergency powers bill, which many other states have. The presence of divided government (Republican governor, Democratic legislature) assisted in the frustration of effective energy policymaking.

The project suggested the following actions to improve policymaking in the state:

1. The State legislature should relocate the State Energy Division into the Department of Natural and Economic Resources. The Civil Preparedness network should continue to be utilized as an emergency energy information system. Decision-maker: State legislature.

2. The State energy division should plan and implement energy conservation programs for industries and residences in the State.

It should work closely with the North Carolina State University Industrial Extension Service in all phases of this programming. Decision-maker: State Energy Office, funding from State Legislature.

3. State newspapers and the electronic media should devote increased attention to State energy programs and less attention to nationally-directed criticism.

4. Guidelines for local government energy crisis early warning and conservation should be promulgated through some State level intergovernmental mechanism such as the civil preparedness network or the Local Government Commission. Local government performance in this area should be monitored at the State level. Decision-maker: State legislature and energy office.

5. The legislature should pass a comprehensive energy facilities siting bill as soon as possible. The Southern Interstate Nuclear Board is one interstate agency that can offer assistance to the legislature on model legislation in this area.

6. The Federal Energy Administration should coordinate more closely its regional offices, especially its Atlanta office. It should increase, not decrease, the discretion of the regional offices in implementing allocation, conservation, and research policies.

7. University agencies which provide consulting and research services to State and local governments should serve as formal advisory organizations in the energy area, perhaps utilizing the individuals who presently advise the State informally.

Reference copy: Institute of Government Library, North Carolina at Chapel Hill

****

Therapeutic Effects of a Special Summer Camp Experience on Physically Handicapped Children (Grant no. GY-11537)

University of Virginia
Charlottesville, Virginia 22901

June 10, 1974 - August 26, 1974

Participants:

Michael W. Chapman
Robert B. Hampson*
Jerry L. Jones
Charles S. McGee
Brian D. Robie
Jonathan Walker
Mary F. Witt
Sheldon B. Zablow

*Student Project Director

Joseph B. Tavormina, Faculty Advisor

Previous research has implied that physically handicapped children are "at risk" and emotionally vulnerable, and that the presence of a physical handicap exerts negative effects on both the child and his parents. Camping has been considered one therapeutic procedure for such families; the large number of camps for children with specific disorders attests to their widespread acceptance. In this light, the following hypotheses were generated for the present study: (1) a camp milieu will be therapeutic for the handicapped children who attend, and will provide parents with beneficial respite time; and (2) specially-devised programs within the camp will have more therapeutic effects on the subset of campers who receive them.

The present study was a program evaluation of Camp Holiday Trails, located in Charlottesville, Virginia. The medical handicaps represented by the camper population included diabetes, asthma, cystic fibrosis, and hearing impairment.

Data were collected from 144 families of handicapped children in the State of Virginia. Seventy-seven families had children who attended camp; the remainder served as non-camper controls. Campers and their families were assessed one week prior to and one week after camp participation. Similarly, the control families, matched on demographic variables with campers, were seen at the same time intervals.

A multiple criteria strategy was employed to provide as broad-based an assessment as possible. Multiple measures were chosen to include an evaluation of any area potentially affected by the camp experience. The children were assessed using measures completed by the child himself, his parents, and camp personnel. Instruments included a measure of self-concept, a locus of control scale, a personality inventory, and a variety of interviews and knowledge tests of the child's awareness of and reaction to his handicap. In addition, each parent was assessed on a variety of measures, which encompassed parental attitudes in child-rearing, the parents' reports of the child's level of functioning and specific behaviors, and a personality inventory. In addition, a parent interview was administered to assess parental reaction to the child's handicap and perceptions of the effects of the handicap on the entire family.

Aside from the normal camp activities and experiences, which included swimming, boating, arts and crafts, and sports, certain subsets of campers participated in special programs developed by this year's project staff. One program utilized eight junior counselors as peer therapists for campers with undesirable target behaviors, employing behavioral techniques to implement change. It was hypothesized that the junior counselors would also change as a result of being placed in the "helper" role.

Another program utilized Lazarus' (1971) assertion training procedure on a subset of 21 campers, on the hypothesis that greater acceptable expressions of personal rights and feelings would lead to a general increase in health in handicapped children. This procedure includes a series of verbal and physical exercises designed to enhance the self-confidence and self-reliance of participants.

The creative dramatics class was designed to test the hypothesis that Gestalt techniques will lead to increased body awareness, increased self-expression, and a reduction in inhibitions. Techniques used with this subset of campers included role-playing, body awareness exercises, skits, and full-length dramatic productions.

Finally, medical students taught medical concepts and self-therapy skills to campers. The goal was to foster independence for each child in the management of his handicap.

To test the hypothesis that change would occur in the campers versus the non-campers, a series of three-way ANOVAS (camper-control x disease x time) was run on each measure. Overall, there were no significant changes in the campers as compared with non-camper controls. Although there were some changes in isolated measures, there was no systematic improvement in the total camper population as a result of the camper experience. Several explanations may account for this.

First, the measures selected may not have tapped the appropriate parameters; if change did occur, then the instruments used may not have been sensitive enough to detect it. Secondly, the time span involved (two weeks for most campers) may have been too short for change to occur. Or, thirdly, Camp Holiday Trails as it existed in 1974 did not serve as a therapeutic intervention for the campers.

However, perhaps the most plausible explanation revolves around the finding that the children studied, both campers and controls, were functioning "normally" across the standardized personality measures. Certainly this finding dispels the age-old presumption that handicapped children are "at risk" and more emotionally vulnerable than their normal peers. On self-concept, anxiety level, and self-evaluation measures, no overall differences were found between the sample and the standardization norms. Therefore, if the camper children are functioning "normally" at outset, there may be no reason to expect them to "improve", nor should they, on these measures, as a result of two weeks of summer camp.

Still, the campers' self-reports (interviews) reveal that camp provided them with a "fun time" and new friends; the camp proved worthwhile to the children from their perspective. Campers most frequently reported making friends as the most positive aspect of camp, followed by enjoying the camping activities.

In addition to the enjoyment the campers reported, positive learning experiences were derived as a result of the specialized therapeutic programs developed for camper subpopulations. Those who attended assertion training classes became significantly more assertive in behavior and attitudes, as measured by three assertion indices, than did either campers who did not attend, or non-camper controls. Also, those campers who were treated through individual behavioral programs by peer therapists improved in their target behaviors. Examples included alleviation of bedwetting, instituting appropriate eating behaviors, and programming campers to manage their own therapy programs.

Child and parent reports indicate that the campers' medical knowledge and therapeutic self-management increased dramatically as a result of their medical education at camp. For example, 42% of the diabetics interviewed learned to do their own therapy at camp, and 37% of all campers reported learning more about the management of their handicaps. Finally, counselor ratings on the hearing-impaired children who participated in the creative dramatics class demonstrated improvements in the quality of their personal interactions. Since the hearing-impaired children scored as the most isolated of the children tested, this intervention clearly was therapeutic for this population.

The second phase of the study, the analysis of respite for the parents, showed that the camp provided a systematic relief from the day-to-day management and stress of their child's handicap. Mothers of handicapped children were found to be in need of rest more so than fathers. At the outset, mothers in the total subject pool were significantly more unstable and less extroverted than the fathers, whose scores approximated the reported scale norms. Also, the mothers reported more behavior problems with their children and more areas of overall concern than did the fathers.

Overall, parents of campers became significantly more accepting of their child, and confident in their parental role, as compared with control parents. In addition, the camper parents became significantly more "extroverted" across time, reflecting decreased inhibitions and greater optimism. These parents derived benefit from the rest that camp provided, which supported the original hypothesis.

The project has demonstrated that a camping experience had some positive effects on the campers and their parents. More importantly, the myth of handicapped children as necessarily "at risk" and emotionally vulnerable has been dispelled, at least for the medical handicaps represented in the study. However, it is clear that it is the parents, especially mothers, who pay a price for their handicapped child's well-being.

Since the most positive changes for campers were derived from special individualized programs, there is a need for expansion and evaluation of such programs, including (1) further assessment of each child's strengths and weaknesses in his ability to cope; (2) individualized programming designed to meet the needs of each camper; and (3) relative effectiveness of the therapeutic agents (counselors) in dealing with each child. In addition, there is a continued need to assess the effects of a periodic respite for the parents of handicapped children as a therapeutic device. Since this effect has been effectively demonstrated, it has implications for parents across a variety of situations, not just in camping.

Finally, the study has presented a cogent and workable model for a program evaluation of a large-scale intervention procedure. The use of multiple measures, a large number of matched subjects, special sub-programs, and comparison of intervention techniques were important components in the systematic analysis. Similar systems interventions can be facilitated by utilizing the methodology suggested in the present study.

Reference copy: Biology/Psychology Library, University of Virginia

****

Renovating Decaying Urban Areas: An Analysis of Seattle's Pioneer Square Historical District (Grant no. GY-11471)

University of Washington
Seattle, Washington 98195

September 30, 1974 - December 6, 1974

Participants:

Laurel Andrews
Jeanette Barker
Fred Dong
Robert Fish
Bruce Flory
Gabriel Hanzeli
Vera Ing
Ronald Muffett
Mark Nerheim
Paul Ng*
Mike Walsh

*Student Project Director

Judith A. Thornton, Faculty Advisor

The Pioneer Square District, located just south of Seattle's central business district, consists of 58 acres of older buildings, most of which date back to the turn of this century. This area was once the center of Seattle's social and business life, but with the gradual shift of new businesses to the north, Pioneer Square faced a steady decline. This trend was halted when it was recognized that the buildings were of considerable historic and architectural significance. Consequently, Pioneer Square was declared an historic district. Severe restrictions were placed on alterations and new construction in the area and the city of Seattle has supported the district through public investment and such policies as locating many of its offices there.

In our work, we have attempted to use the tools of analysis provided by economics and sociology to identify some of the changes that have taken place in the Pioneer Square Historic District (PSHD) and to do some preliminary evaluation. The nature and uses of Pioneer Square have significantly changed over the past decade. In order to examine the changes that have taken place, it is necessary to understand the institutional framework affecting the area. Consequently, forces that influence land use were examined. Legislation which is designed to preserve historic areas, zoning laws, the review board which was created to oversee preservation of the PSHD, and the general economic environment were studied.

When analyzing the existing conditions in the PSHD, one should also consider other possible institutional settings that could have occurred. Two other possibilities which were considered by the city were to do nothing or to carry out urban renewal. Analyzing the possible results of these options provided additional background for evaluation of the actual changes that have taken place.

Methods of evaluating the results of the historic ordinance and capital investments made in the area were explored. Input-output analysis can be used to measure the returns to society on public investment. Unfortunately, there are practical and theoretical considerations which render this model of limited value when conducting an analysis of such a small geographic area.

Cost-benefit analysis turned out to be more useful. With this tool, a measurement of the costs and benefits from the city government's point of view (in terms of money spent and taxes collected) and from the point of view of society as a whole were made. In the former case, it was found that the city will not collect enough in increased taxes to pay for the capital investments it made in the PSHD. On the other hand, it was determined, by using cost-benefit analysis, that the result of public (local and Federal) and private investment has been to increase society's wealth.

This analysis, though, does not consider redistribution of wealth, i.e., who is bearing the costs and who is collecting the benefits resulting from this project. The rest of the report is devoted to examining specific costs and benefits to particular groups.

The crime rate in the PSHD has fallen. More shoppers are in the area, and more police are there to protect them. From a personal standpoint and because low crime rates are a plus factor for attracting retail customers, residents, landowners, and shopowners have benefited.

The housing stock has decreased in the PSHD since 1960 and commercial and office space in the area has increased. The effects on rental rates of remaining housing in the PSHD and similar housing in nearby communities were analyzed with respect to the costs imposed on residents and relocatees. The benefit of increased commercial and office space to users (since more supply results in lower rents) is also considered.

Lastly, social costs and benefits to residents were explored. This was done by interviewing current and former inhabitants of the PSHD. Some of the costs identified were the monetary and psychological costs of relocating one's place of residence and the reduction of low-cost private services used by residents (such as cheap places to eat). Improved access to social and health services, increased police patrol, and more parks were among the benefits isolated.

As an outgrowth of our research, certain recommendations have been formulated; we recommend that:

1. When evaluating the success of the Pioneer Square Renovation, the city consider more fully its probable impact on various sectors of our society rather than consider only the possibility of increased tourism and higher property values.

2. City decision makers analyze their projects in terms of the costs and benefits to society as a whole and to its coffers. In addition, the extent to which city ordinances may become politically or economically irreversible should be considered prior to their passage.

3. Regulatory authority of the Historic Preservation Board be strengthened and that it work with the Special Review Board governing the areas to jointly identify their areas of conflict and common interest.

4. Government agencies record resource expenditures by geographic area.

5. The free bus service in the downtown area be continued.

6. The health station and the Skid Road Community Council continue to receive funding.

7. The existing housing stock and traditional services catering to residents be preserved.

Reference copy: The Northwest Collection of Suzallo Library and the Law Library, University of Washington.

****

Noise and Exit Congestion Related to I-280 in Newark, New Jersey

(Grant no. GY-11510)

Newark College of Engineering
Newark, New Jersey 07102

June 10, 1974 - August 16, 1974

Participants:

Pamela (Powell) Chromowsky
Scott Kampe
Thomas McCloud
Michael J. Moore
Parikh D. Motilal
Louis R. Papale*
Vincent Rocca
Thomas J. Solecki

*Student Project Director

Frederick G. Lehman, Faculty Advisor

The two problems examined for this project were an investigation of exit congestion on I-280 at Newark's First

Street Interchange, and the problem of objectionable noise levels in West Orange and Livingston caused by vehicular traffic and road conditions on I-280. Throughout the project, the research staff sought to achieve a reduction of congestion on the I-280 exit ramp by providing for a smoother traffic flow, and a reduction of highway noise in the sensitive residential areas. The members of the project were divided into four working groups to carry out their specific assignments. These included the noise group, the urban studies group, the traffic group, and the research group.

The noise team was responsible for obtaining technical noise data and field locations on and near I-280, as well as for gathering correlative data. They also provided various suggestions and recommendations for the reduction of traffic noise.

The urban studies group was concerned with the human problems that resulted from noise along I-280. They began their research by conducting a door-to-door survey of the people living in the noise-affected areas of West Orange and Livingston. The results of the survey were correlated on the computer, and then analyzed by the group. The recommendations put forth by this group were obtained from the survey of the affected areas.

The problem of traffic congestion in the area of the First Street exit of I-280 was handled by the traffic team. In order to arrive at a solution to their problem, the group began their field work by making traffic studies at various intersections surrounding the I-280 east-bound exit ramp in

Newark. After gathering all the essential data, they studied various ways in which a reduction in congestion and delay could be obtained. Many solutions were investigated, and then limited to the most practical as recommendations.

The research group did investigatory and research work on highway and legal matters, from both printed material and personal interviews with officials who were knowledgeable in areas relevant to the project. They researched materials pertaining both to noise pollution and traffic congestion. This research resulted in some very good ideas for solutions to the problems at hand.

Reference copy: Robert W. Van Houten Library, Newark College of Engineering.

****

Attitudes Toward Education Among Spanish-Americans and Anglo-Americans in a Small New Mexico Town (Grant no. GY-11469)

New Mexico Institute of Mining and Technology
Socorro, New Mexico 87801

May 27, 1974 - August 2, 1974

Participants:

Keith A. Christopher	Linda S. Martinic
Thomas K. Field*	Susan L. Merwin
Frank R. Gonzales	Sandra A. Rovit

Michael M. Schmidt

*Student Project Director

Non-Stipend Participant:

Rodney Torres

Christian J. Buys, Faculty Advisor

Failure of ethnic minorities to achieve collegiate success has long been a major problem in American higher education. Spanish-Americans are a particularly salient example of a minority group plagued by a lack of collegiate opportunity and equality, with Spanish-Americans in New Mexico not immune to this inequality. In the high school studied in the present investigation, evidence of this inequality in educational success clearly existed. Although the Spanish-American students comprise only 60% of the high school population (grades 9 through 12), 75% of the drop-outs in 1972 and 1973 were Spanish-Americans. Lack of Spanish-American educational success in the high school was further evidenced by ranking members of graduating classes on the basis of grade point average. In 1972 and 1973, 60% of the graduating classes were Spanish-Americans, with approximately 42% of the upper third, 69% of the middle third, and 70% of the lower third being represented by Spanish-Americans.

The major purpose of the study was to assess and compare the demographic backgrounds of Spanish-Americans and Anglo-Americans and their attitudes toward various parameters of education which might affect college entrance and success. To this end, a group of Spanish-American high school students and their parents were compared with a group of Anglo-American high school students and their parents. The demographic variables included, among others: SES (indicated, in this study by mean status of respondent in the three ranked systems of head of household's occupation, income, and education); religious conservatism; number of children; and number of newspaper and magazine subscriptions. Likert scales were developed to measure attitudes toward the following domains: college preparatory classes and college attendance; high school experience as worthwhile and adequate for college preparation; satisfaction with high school atmosphere; home environment as conducive to students' education; a good education as a necessity for successful life; and vocational training. In addition, data were gathered concerning post-high school aspirations; bilingual education; natural and physical sciences; humanities; and a number of other variables. Measures of the above demographic and attitudinal variables allowed qualitative and quantitative comparisons among Spanish-American students, Spanish-American adults, Anglo-American students, and Anglo-American adults.

Seventy-five Spanish-American students and 75 Anglo-American students were selected randomly from the only local public high school in a central New Mexico city (population 4,800). The Spanish-American and Anglo-American students were chosen from within two grade levels (ninth-tenth and eleventh-twelfth) to assure that the entire population of the high school was represented in the sample. Ethnic affiliation was determined by surname. Questions concerning a student's ethnic origin (8% of the high school was from mixed Spanish-Anglo backgrounds) were clarified by a counselor at the high school. Over 95% of the projected interviews were completed, yielding a final sample of 70 Spanish-American students and 71 Anglo-American students. The adult portion of the sample consisted simply of the parents (head of household) of the student sample. Essentially, the parental sample included fathers (60 Anglo-American fathers and 51 Spanish-American fathers).

The final questionnaire included 12 questions to assess the respondents' demographic background and 7 Likert scales to assess the respondent's attitudes toward educational parameters. A students' form and parent form of the questionnaire were developed. Each form contained minor wording differences appropriate for the respective groups. The final draft of the questionnaire was reviewed and endorsed by the teachers and administration of the high school and the local Board of Education.

Three teams of two advanced undergraduate students conducted the interviews in the homes of the respondents during the summer of 1974. Three of the seven students who comprised the teams were bilingual, two being of Spanish descent. Before the study commenced, each student conducted five practice interviews. The students, along with a faculty advisor, observed each others' practice interviews through a one-way window and interchanged helpful suggestions concerning interview techniques.

The average interview took 30 minutes. Appointments were arranged simultaneously with the student and the head of the household. One member of the team interviewed the student, while the other member interviewed the head of the household. In accord with recent ethical guidelines established for research conducted with human participants, all respondents were informed of the nature and intent of the survey, and assured of the complete anonymity of their responses.

Results showed clearly the existence of striking differences in demographic backgrounds between Spanish-Americans and Anglo-Americans. The SES disparity, transposed into real life figures, meant that Spanish-American adults when compared with Anglo-American adults, averaged 6 years less education (56% of the Spanish adults had not graduated from high school and less than 2% had graduated from college), averaged $7,000/year less income (48% of the Spanish adults earned less than $6,000/year) and were employed mainly (72%) in blue collar jobs. Finally, Spanish-American adults attented more conservative churches with greater regularity, had significantly more children, and had significantly less reading material in their homes.

Spanish-American students, when compared with Anglo-American students, differed significantly in their attitudes toward several of the educational parameters. Spanish-American students perceived the high school as worthwhile, were more satisfied with the high school atmosphere, perceived their home environment as less conducive to education, and placed more value on vocational training. Spanish-American parents and Anglo-American parents exhibited similar and more clear-cut attitudinal differences, although Spanish parents placed less value on college preparatory classes and college attendance. In addition, Spanish-American parents, in contrast to their children, perceived their home environment as conducive to education.

Intercorrelations among Spanish-Americans' and Anglo-Americans' SES and their attitudes toward education showed that parents' SES, regardless of their ethnic origin, tended to be positively correlated with attitudes toward college preparatory classes and college attendance and negatively correlated with attitudes toward the quality of the high school, the necessity of a good education for a successful life, and the value of vocational training courses. It is interesting to note that the SES background of the students did not significantly correlate with these same attitudinal scales. Significant and positive relationships for all Spanish-Americans and Anglo-Americans were obtained between their attitudes toward home environment as conducive to education and the value of a college education, the necessity of a good education for a successful life and the quality of the high school, and the value of vocational training and the quality of the local high school. Three notable similarities in significant correlations between attitudinal scales were obtained for Spanish adults and their children: favorable attitudes toward the home environment were associated with positive attitudes toward high school and the necessity of education for a successful life, while endorsement of education was also associated with endorsement of a vocational training program. Only Spanish-American students had a significant and positive relationship between their attitudes toward their home environment and vocational training.

Several other noteworthy results were obtained. These were:

1. SES of Spanish-American adults was negatively correlated (-.53, *p* .01) with endorsement of bilingual education programs. However, on a percentage basis, more Spanish-American students

(72%) and adults (83%) favored bilingual education than Anglo-American students (44%) and adults (40%).

2. Only 52% of the Spanish-American students, in contrast to 75% of the Anglo-American students, felt free to ask their parents to help them with their homework.

3. More Spanish-American students (50%) than Anglo-American students (35%) indicated a desire to attend trade schools. Similarly, more Spanish-American adults (84%) than Anglo-American adults (61%) felt more vocational training programs should be offered in the high school.

4. Fewer Spanish-American (57%) than Anglo-American students (69%) planned on attending college.

The net result of this study is disturbing. The demographic and attitudinal data showed clearly that Spanish-Americans are faced with two interrelated and seemingly insurmountable barriers in attaining collegiate success: a continuing legacy of inferior social status and its accompanying lower educational aspirations and expectations, not to mention a society which has yet to rid itself of pervasive ethnocentrism. These findings indicate that if Spanish-Americans' collegiate success is to be enhanced, major changes must take place in their SES, home environment, and educational aspirations. While this may seem an impossible task, Spanish-Americans' increasing awareness of their educational plight in America constitutes a signal that conditions are ripe for improvement.

Reference copy: Speare Memorial Library, New Mexico Institute of Mining and Technology

****

An Environmental Inventory for Urban Planning and Development

(Grant no. GY-11467)

University of Northern Iowa
Cedar Falls, Iowa 60613

June 4, 1974 - August 13, 1974

Participants:

Elaine Burkhart	Esther E. Harrington
Pauline Drobney	Danny Knudtson
Ada Eggleton	Colette Penne*
Susan Fauerby	Mark Schreiner

Stephen Wiig

*Student Project Director

Robert C. Goss, Faculty Advisor

Data were gathered on an undeveloped, mostly agricultural area south of the University of Northern Iowa, which because of its proximity to the university and existing residential areas, is likely to be expanded. An urban area was studied which lies just to the north and east of the university. This site was representative of a developed area and contained both single and multiple dwelling units and a light commercial area. Each area has a branch of Dry Run Creek running through it, a north-flowing stream in the rural site and an easterly-flowing stream in the urban area.

Prairie remnants were discovered in the agricultural area. Of the most important species of lowland prairie forbs as listed by Weaver, 47% were found on the railroad tracks. Of the plants listed as being of secondary importance in lowlands, 21% were found. Thirty-one percent of those listed as being the most important forbs of an upland prairie were found, and those of secondary importance to uplands, 13%.

In the urban area, two plants designated as rare, one plant which had not been reported from the county, and one which is not reported in the Vascular Flora of the Iowan Area were located.

Specimens of Lepidoptera were collected once a week in each area to determine the frequency of occurrence. In the urban area, 43 specimens from 9 species were collected. The rural area yielded 69 specimens from 13 species, four of which were not found in the urban area.

Mayfly adults were collected by the use of ultraviolet light. The mayflies were separated into six of the most common genera. The two areas differed greatly, with Baetis being the most common in the urban and five others more common to the rural area. The differences found between the two areas indirectly indicate the type of stream present.

Stone walls, rocky ledges, and downed timber were more common to the urban stream because of the man-made structures and waste materials introduced. Because of this, more snakes were observed in this urban area.

In August, the Chicago Great Western Railroad Company was clearing trees around a railroad bridge and using the herbicide, Atratol 8P. The applied herbicide was quite concentrated in patchy areas, as if poured by hand rather than spread by machine. Because of the steep slopes and nearness to the creek, it was estimated that a good share of herbicide was washed into the stream, thus making its way through the residential area.

The rural and urban stream velocities show the rural stream to be typical of a natural stream, with regions of swift water, as well as regions of slow water. At first, the urban stream appears to be similar to the rural stream, but there is a sudden drop in velocity followed by a sudden peak. As the water moves downstream, the velocity slows and becomes a rhythmic fluctuation similar to that observed in the rural area. The urban stream was slower, 18.4 cm/second, as compared to 33.9 cm/second in the rural stream.

Tests were made for temperature, dissolved oxygen, turbidity, conductivity, pH, sulfates, iron, nitrites, and nitrates. It was found that the University was causing major disturbances in the urban stream by discharging water from the cooling system. There are three major factors contributing to the stream from the outflows: a) less oxygenated water; b) greater volume of water; and c) substantially cooler water.

Chemical Water Quality

	Rural	Urban
pH	7.7	7.7
dissolved oxygen	7.5 ppm	8.5 ppm
% saturation dissolved oxygen	73-103% fair-good	75-93% fair
temperature	16 - 25 C	11 - 19 C
nitrate	6 ppm	1 ppm
nitrite	0.025	0.03
iron	0.10 ppm to 0.50 ppm	0.05 ppm to 0.14 ppm
turbidity	10 - 25 JTU	0 - 10 JTU
conductivity	280 - 325 ppm NaCl	225 - 275 ppm NaCl
sulfate	25 - 45 ppm	10 - 30 ppm

The topography of the agricultural area can be described as gently rolling hills dissected by numerous erosion gullies. The south branch of Dry Run Creek runs northeasterly through the center of the section and two low ridges follow on either side of the stream, approximately 60 feet above the stream terrace.

Several major drainage channels cut across the slopes and empty directly into the creek. Numerous minor drainage channels cut the slopes, but do not empty directly into the creek; rather, these gullies end in small poorly-drained depressions.

It is hoped that carefully planned designs will be used for the development of the residential district in the agricultural area. Serious problems encountered with the residences in the urban area are flooded basements and yards. This is not uncommon for homeowners whose houses are built directly on Dry Run Creek's flood plain. Obstruction of the stream channel occurs because several structures protrude directly into the creek bed. These problems are compounded by the fact that water runoff carried by storm sewers during rainstorms is being piped directly into the creek. When the creek rises to a point that covers the storm sewer outlets, the sewers back up and flood the streets, producing a traffic hazard.

One type of housing that will work most effectively is the town house (row house) apartment, in combination with individual unit homes. Private yards and parking are allotted for each unit in the town complex. Three different size units will be offered to meet the needs of individual families. Each unit will be double storied, with bedrooms on the second floor.

The houses are located on top of the ridges while the ridge slopes are planted with contoured row crops. The stream terraces along Dry Run Creek will be left in the natural state as a permanent greenbelt and developed into a learning area.

Reference copy: University of Northern Iowa Library

****

Land Use Futures for the City of Buffalo (Grant no. GY-11515)

SUNY-State University at Buffalo
Buffalo, New York 14214

June 4, 1974 - August 24, 1974

Participants:

Julian Benjamin	Pradip Kumar Ghosh*
Kumkum Ghosh	Gary Nadler

K. Srikantham

*Student Project Director

George C. Lee, Faculty Advisor

Ideal cities can be developed only by preserving an intimate relationship between the city as a social system and the city as a landscape. This has become the main concern of urban ecologists. The cities have developed as a part of the social and economic system. To keep this system going, it is very important that there should be an ideal spatial distribution related to different activities. The urban community is very dynamic in its nature and constantly changing to meet varieties of needs arising out of the changing pattern of activities.

The construction of a land use inventory and its analysis are very important in the preparation of an efficient and productive city plan. The applications of land use data for planning purposes are numerous. They can be used to determine the growth of the city.

To understand the nature of change in central cities like Buffalo, we must understand the changes in function. The statistical data reveal that the city is undergoing economic decline since the middle of the 1960's, combined with a high rate of unemployment, falling prices for residential land and outmigration of industries from the area. Study of land use changes may focus on these functional changes. There are some built-in restraints which affect a change in the land use pattern. Firstly, the inability of the central city to adapt the technological innovations by fixed capital investments which results in the unsuccessful attempt to compete with the suburban marketplace. Secondly, the incapability of the social system to adapt and accept the necessary changes in the existing living conditions. These restraints have a great deal of effect in the growth or decline of the city.

The general purpose of the study has been to understand the present land use situation in the city of Buffalo, how it has changed since 1960, and how it might change in the future. The goal of the project is to bring out a profile of the city. The study is divided into three parts. The first part explains the existing land use pattern related to residential, commercial, industrial, transportation and community facilities utilization. The second part attempts to study the future land use changes in the city, while the third part makes an effort toward some major conclusions and summarizes land use futures for the city of Buffalo.

The study attempts to analyze land use changes, using the time series projection methodology in a more or less controlled situation. Data were collected from varieties of different sources, including ten different departments in the City Hall, for 1960, 1965 and 1970. The data sets were aggregated to each of the 87 census tracts. In the analysis, the use of the mathematical function for forecasting assumes that past growth has followed some law of growth in which the dependent variable is explicitly some function of time and that future growth will follow a pattern which is predictable from this relationship. The simplest of the mathematical functions is the first degree polynomial which derives from constant increments in the dependent variable per unit of time. The most fundamental criticism of using a polynomial curve fitting procedure is that many of these curves do not have any upper limit. Though it is understandable that urban growth may continue for an indefinite period of time in the future, it is impossible that the size of the dependent variable could reach infinity, especially within an area of limited physical size. For this reason, researchers use the logistic exponential curve fitting procedures. But the land use data for the City of Buffalo indicate that the variables in most areas are decreasing and these decreases are not compensated for by relatively stable dominating variables. It is quite conceivable that a model of constrained, positive growth, such as the logistic function, is inappropriate. Based on data limitations of three observations for each of the 87 census tracts and each of the 42 variables, the linear form is the best that can be used, with the only constraint: non = negative variables.

The analysis should describe changes in spatial distribution that result from various factor changes. This can be attained by describing the attractiveness of each cell and then allocating factors to the most attractive cells subject to physical constraints. Factors were described, using factor analysis techniques, and the observations were considered for each tract and each year. The major factors centered around the mobility of various contributing variables. By following the principal component analysis these groupings are logical. A close examination of the data would illustrate that they represent things that should vary together.

Analysis of these factors by regression analysis, by calculating the averages and fitting a line through variable totals, yields unconstrained predictions for 1975, and 1980. The analysis illustrated in the following table shows that local and residential variables, as well as industrial growth are all leaving the city simultaneously.

Mean Proportions of Land Devoted to Various uses City of Buffalo, based on the Principal Factors, 1960-1980

FACTOR	1960	1965	1970	1975	1980
I Local and Residential	35.48	33.02	32.61	30.86	29.45
II High Density and Light Industry	2.24	2.30	2.49	2.60	2.73
III Heavy Industry	1.18	1.21	1.23	1.26	1.29
IV Regional Commerical	23.97	23.62	23.52	23.58	23.24

	1960	1965	1970	1975	1980
V Medium Industry (A)	.11	.14	.17	.19	.21
VI Commercial Residential (Multi-Family)	.68	.61	.58	.52	.47
VII Commercial Residential (Single-family)	1.56	1.40	1.37	1.25	1.15
VIII Medium Industry (B)	.31	.32	.43	.47	.53
IX Vacant and Open Space	34.47	37.38	37.58	39.57	40.88
TOTALS	100.00	100.00	100.00	100.00	100.00

A close observation of the results would indicate that looking at the city alone is insufficient. Rather than the variables being excluded because of outbidding by higher variables or by capacity constraints, variables are being drawn to other areas by some measures of attractiveness. Therefore a regional view would be more appropriate. From the analysis, the general trends can be extrapolated from the five-year periods of 1960 to 1965 and to 1968, but significant variations from these trends can be observed in the periods 1965 to 1970. In terms of using the data for projection land use, it would be worthwhile to analyze the marginal utilization rates. These trends in the utilization rates are the most significant indicators of land use growth and change. Their variation through time and between categories of land use reflect the changing values of the population. In summary, with its declining rate of growth in the late 1960's, Buffalo has experienced a continually lower rate of land consumption resulting in a less densely crowded city of the future.

Reference copy: Library, SUNY-State University at Buffalo

****

Modelling and Simulation for the Construction Industry

(Grant no. GY-11496)

California State University at Sacramento
Sacramento, California 95819

June 16, 1974 - September 7, 1974

Participants:

Yoichi Akiba*	Man-Tim Lee
Vija K. Bhargava	George Y. Li
Nancy Blom	Hung Nguyen
Do H. Chuyen	Richard O'Brien
Gary S. Duran	Debra B. Sternberg
G. Miles Johnson	Chaklam Tam

*Student Project Director

Leo Dabaghian, Faculty Advisor

Construction is California's largest industry with three times the dollar volume of that of agriculture. California State University has cooperated with the regional construction industry in establishing new educational programs, as well as by conducting joint studies and investigations in support of industry needs. The Construction Education Program (CEP), sponsored by the Associated General Contractors of California to provide professional guidance to the industry, has given material support to the University. In this project CEP has contributed guidance in the selection of, as well as facilitating access to and consulting with, contractors, builders, and architects.

This project aimed to provide mutual benefits to both the student and to industry. Participants developed and applied new methods, but most of all, by applying theories to actual industry problems, learned how to identify and overcome difficulties. Our project addressed itself to the following obstacles:

1) bring together theory and practice
2) narrow the gap between usable theories and the complexity of real world problems,
3) emphasize usefulness to industry, particularly cost-effectiveness for small business.

We need help from industry to discover:

1) what their needs are,
2) where the job markets lie,
3) how to implement new technologies promptly as they emerge.

The method applied represents construction operations and processes in terms of "modules" using the HAD (Happ, Akiba, Dabaghian) modular network simulation technique. This technique uses a "standard" library of generalized modules to represent frequently recurring industrial, environmental, social, and/or experimental processes in modelling complex systems.

The method developed can be used by both small and large job contractors, as well as field managers. This method goes beyond the scheduling level, as in CPM and PERT, to the level of processors, analyzing the construction components of labor, equipment, haul distance, material supply, etc. This is accomplished by sub-dividing the jobsite situation or any other industrial system to levels of sub-operations such that the manager or project engineer, or even a secretary who is familiar with a jobsite and/or system, can conduct simulation experiments.

Benefits accruing from the use of method are:

1) a systematic consideration of the overall problem based upon building up the system from modules representing recurring work patterns can reveal to the analyst whether system weaknesses reside in the interlinkages of the component sub-operations or in the parameters of the components;

2) having once identified sensitive areas, simulation quantitatively indicates how the problem might be solved;

3) the modelling technique provides an engineering language which constitutes a common point of reference such that construction operations and their linkages can be discussed quantitatively.

Table 1 shows seven topics around which our work was planned. Each topic was approached by using all or some of the following activities:

1) apprenticeship and skill acquisition;
2) bibliography and information inventory;
3) development and validation of the HAD modular approach;
4) case studies;
5) documentation and report utilization.

Table 1. Project Topics

I. The HAD Modular Network Simulation Technique

To acquire working knowledge of:

1) the modular modelling technique;

2) the library of HAD Modules;

3) the time sequence diagram; and

4) GERTS III Q primitives.

II. Technical Report for Presentation to Industry

To develop a technical presentation which will convey the project scope to industry people at meetings.

III. Library Search in "Simulation and Modelling for the Construction Industry"

Background studies for construction industry:

1) to compile an authoritative summary of simulation techniques useful to the construction industry;

2) to highlight and describe industry trends;

3) to identify key experts with addresses;

4) to prepare an annotated bibliography.

IV. Case Studies

To model and simulate representative construction industry processes.

V. Validation of HAD Modules

To validate the library of HAD Modules using GERTS III Q as a host component system, and to develop needed extensions of GERTS III Q such as GERTS CQ.

VI. Networks for Simulation Experiment

To apply network techniques to several industrial systems.

VII. Computational Support

To extend the features of GERTS III Q and document input procedures, functions and mechanics of the modules.

Reference copy: Library, California State University at Sacramento

****

Observational Field Study of Adult and Child Interactions

(Grant no. GY-11441)

University of Virginia
Charlottesville, Virginia 22903

April 15, 1974 - July 8, 1974

Participants:

George Donahue
Dean Kauffman
Wade Mackey*
Howard Ottenheimer
Mary Anne Pitman
Susan Scurlock
Robert Stewart
Nona Tapscott
James Thomas

*Student Project Director

Edwin E. Erickson, Faculty Advisor

Paternal behavior is, at present, an area which has been little studied. Human paternal epimeletic behavior in the field, unencumbered by laboratory constrictions, is virtually untapped by the social sciences. This project was organized to incorporate students from varied disciplinary backgrounds who would study adult-child epimeletic behavior in the field. Epimeletic behavior is defined as nurturant or care-taking behavior.

This investigation was interested in several variables of adult-child interaction: gender of adult, gender of child, developmental status of the child, race, urban-rural residence. A coding system was devised to record on ordinal scales different kinds of interactive behavior. The scales were constructed to be as objective as possible with minimal interpretation and maximal description. The behaviors included relative degrees of tactile contact from adult to child, personal distance of adult from child, and inclusion of the child in the adult's visual field.

The coding system was successfully tested for inter-judge reliability for the nine observers ($p < .01$). The nine observers included two psychology students, one education student, one ethology student and five anthropology students. These nine, at over 125 observation sites, collected 13,792 interactions between adults and children. All sites were in locales of public access and of equal access by gender. All observations were within daylight hours. Uni-gender adult groups were coded separately from bi-gender adult groups. The data were collated, analyzed and redistributed to the participants.

The significant results ($p < .01$) generated from the data include:

1. Adult females are proximate to children of both genders at a greater frequency than are adult males.
2. Adult males, when present, interact with children in the same manner as do adult females.
3. Adult females are proximate to girls at a greater frequency than they are to boys.
4. Adult females are proximate to older girls at a proportionally higher frequency than are adult males.
5. Adult males are proximate to boys at a greater frequency than they are to girls.
6. Adult males are proximate to older boys at a proportionally higher frequency than are adult females.
7. As measured by the frequency of proximate associations, there is no consistent preference for gender of child

by groups of adults of both (bi-gender) adult groups.

8. Compared to single gender adult groups (uni-gender adult groups), adult groups of both genders are proximate at a proportionally higher frequency to younger children.

9. For time intervals when adult males are not normally precluded from access to children because of socio-cultural imperatives, e.g., working at a job, the projected range of percent of proximate association between children and adult male-only groups is between 8% and 27% of the total number of proximate associations.

10. For time intervals when adult males are not normally precluded from access to children because of socio-cultural imperatives, e.g., working at a job, the projected range of percent of proximate associations between children and adult groups with both adult males and adult females present is between 25% and 41% of the total number of proximate associations.

11. For both genders of adults and both genders of children, the younger the child is, the higher is that child's frequency of interactions with adults.

12. For adult groups proximate to children, the mean number of adults per adult female-only groups is larger than the mean number of adults per adult male-only groups.

13. Adult groups with both adult males and adult females tend to include more children per group than either adult female-only groups or adult male-only groups.

14. For all groups of adults and both genders of children, the younger that child is, the more likely the adult

touches (with the hands) that child.

15. In both uni-gender and bi-gender adult groups, there are no differences between the two genders of adults in tactile contact (touching with the hands) to children of either gender.
16. For uni-gender adult groups, an urban residence, compared to a rural residence, indicates a higher frequency of adult (hands) to child contact.
17. For groups of adults and for both genders of children, the younger the child is, the closer the adult tends to be to that child.
18. In single gender adult groups there are no differences between the two genders of adults in proximity to children of either gender.
19. In adult groups with both genders, the adult female tends to be in closer proximity to girls than boys.
20. For all groups of adults, (except adult males in adult male-only groups interacting with boys), and for all children of both genders, the younger the child is, the closer that child is to the adult's line of direct sight.
21. For all groups of adults and both genders of children, there are no differences between the two genders of adults in their tendency to keep children within their visual field.
22. Compared to adults in "urban" areas, adults in "rural" areas, for all adult groups, more tend to keep their children within their visual field.
23. When compared to adults in rural areas, all groups of

adults in urban areas tend to stay within reaching distance of children.

24. Adult females in rural areas are more prone to touch children than are adult females in urban areas.

The results can be summarized as follows:
Adult females interact with children at a greater frequency than do adult males. Adult males interact with children in the same manner as do adult females. That is, human epimeletic behavior is not gender-dimorphic, although the threshold for its activation may be lower for women than for men.

In a repetition of the nature-nurture continuum, epimeletic behavior between adults and children may be strictly a cultural phenomenon or there may be generalized biological predispositions which may affect adult-child interactions. If these predispositions do exist, then the variability of human social behavior would not be infinitely plastic, but would be channeled within a finite range of behavioral options. The follow-up task for students of human social behavior is to use the highly objective method in this project in other cultural areas and to compare the results.

Reference copy: Sociology-Anthropology Reference Library, University of Virginia

****

Feasibility Study for a Multi-modal Transportation System Serving Florida Technological University (Grant no. GY-11501)

Florida Technological University
Orlando, Florida 32816

Participants

D. Allan Duguid

Charles A. Mason

Sigrid V. King James L. Smoot
Nanci E. Laurrell Michael A. Steffens*
*Student Project Director
George F. Schrader, Faculty Advisor

Florida Technological University is primarily a commuter university, with approximately 93% of the students coming to the campus daily from within an approximate 50-mile radius. Since the campus is not currently served by an effective mass transit system, the student commuters must rely on the automobile as the primary mode of transportation to and from the campus. Considering the scarcity of fuel resources and other problems incident to the movement and storage of automobiles in an urban area, it is obvious that transportation alternatives must be identified and implemented. Thus, the purpose of this project was to determine a feasible mix of transportation modes which would best serve the commuter population attending Florida Technological University.

The project reviewed the existing methods of commuting to the University and then examined alternatives. The alternatives considered were car pools, mini-buses, regular bus service, and bicycles. The analysis of the existing system involved an inventory of travel, which included vehicle loads, major routes, time schedules, etc. Alternatives were analyzed for feasibility, cost, effectiveness, organization, and operational characteristics. The best mix of modes was determined by combining the best aspects of the alternatives.

To determine the needs and preferences of the University community, a comprehensive survey was conducted among a sample of two hundred commuters during the summer quarter of 1974. Students from all four undergraduate levels were represented in the survey sample. For stratification purposes, the survey included questions concerning class rank, college curriculum, credit-hour load, and other academic considerations. Information concerning commuting habits and preferences was collected and analyzed.

A density map of the places of residence of the commuter students was drawn in order to determine the primary areas of concentration of these students within the Orlando urban area. This map was made by manually plotting the addresses of over five thousand commuters on a grid map of the area. This information enabled the project group to locate areas that warranted possible mass transportation services and also provided base line data for calculating average travel distance to the campus.

Information concerning the future growth of the University was obtained by consulting with campus planners and registration officials, so as to provide a basis for predicting future transportation needs. Future transportation plans for the Orlando metropolitan area were gathered through consultation with the Orange-Seminole-Osceola Transportation Authority, the East Central Florida Regional Planning Council, the Florida Department of Transportation and other governmental agencies.

Considering the diversity of student preferences, class schedules, residential locations, and other factors, the project demonstrated that the best mix of transportation modes included car pools, a combination of bus types, and bicycles. It was also determined that, for effective coordination of such a system, the University should establish and operate an Office of Transportation. This was recommended to the University.

The study concluded that car pools could best be used to serve the majority of commuters since their residence locations are not sufficiently close together to make mass transportation services feasible. As recommended by the project study, the actual conduct of the car pool program would be left up to the individuals involved, but the University should provide coordination information. A computer program for the car pool coordination system was developed. Information needed for computer coordination is to be collected for all students at the quarterly registration period.

The project also recommended the establishment of four shuttle-bus and two park-and-ride bus routes to serve different commuter locations. One shuttle-bus route would operate continuously during the day to serve apartment complexes within the immediate vicinity of the FTU campus. A second shuttle-bus route was recommended for the Winter Park Pines area where the student commuter density was found to be over 195 students per square mile. This route would cover a distance of 17.8 miles per trip and would be operated six times daily. A third shuttle-bus route was proposed for the Maitland, Florida area and would operate over a distance of 16.3 miles each trip with six trips per day. The last shuttle-bus was suggested to serve the Oveido, Florida area which has a high faculty and staff population. This 13.4 mile trip would also operate six times daily.

One park-and-ride bus route was recommended to provide service to and from Titusville, a community approximately 34 miles from the FTU campus. It was suggested that a parking compound be located at the Brevard Community College to permit park-and-ride students to leave their cars in that location. The other park-and-ride route would serve the Pine Hills area in Orlando on a route run of approximately 40 miles. Both of the park-and-ride buses would make four round trips daily.

The third mode of transportation would be facilitated by the construction of three bicycle paths along existing road rights-of-way in the FTU area. The first pathway would parallel State Road 520 (Alfaya Trail) extending from FTU south to State Road 50, a distance of approximately two miles. The pathway proposed for this section would be 7 feet wide, 3 inches thick, and would be constructed with deep strength asphalt. The route would require about 15 bicycle path signs per mile and signs and striping for 5 intersections per mile. Construction costs for this path were estimated at $29,687 per mile.

A second bicycle path was recommended to parallel FTU Boulevard from FTU to Semoran Boulevard, a distance of 6.9 miles. This path would be similar in construction and cost to the previous path. A third pathway was proposed to run along Alfaya Trail from FTU north to Oveido, for a distance of five miles. This path would be similar to the other two, except that it would be only 5 feet wide and cost approximately $21,767 per mile.

The study concluded that the transportation mix suggested should adequately serve the commuter population of Florida Technological University until 1980. It recommended further that a similar study be conducted at that time to determine additional service requirements.

Reference copy: Florida Technological University Library

****

A Study of Urban Crowding in Riverside/San Bernadino, California (Grant no. GY-11516)

University of California, Riverside
Riverside, California 92502

June 17, 1974 - August 30, 1974

Participants:

Edward A. Drury
Nickolaus R. Feimer
Don Flint
Jerelyn M. Hawkins
Teri S. Jamin
Sue C. Owens
Donald E. Schmidt*
Robert B. Stanton
Dianne (Landeros) Threlkeld
George J. Turnbull

*Student Project Director

Roy D. Goldman, Faculty Advisor

Early research into the problem of crowding has yielded some rather provocative results. Ethologically-oriented studies utilizing both natural and synthetic living environments have demonstrated the association between crowded conditions and social or medical pathologies. The same sort of results have been obtained for human populations by correlational studies utilizing census and other demographic data. Finally, stringently controlled laboratory studies have noted some interesting, although often contradictory, findings about the relation of crowded situations and behavioral concommitants. However, in the past, little effort has been made to move the actual crowding research into the urban environment, the ultimate point of application.

The present study was an endeavor to move the concern into the community and applying it to a specific environment that was currently undergoing rapid population growth and increasing levels of density. An attempt was made to translate variables that had been used in past ethological, correlational and laboratory investigations into factors that would be relevant to, and could be measured in a large urban environment. An extensive review of the literature indicated three general classes of variables that might be considered. These included physical measurements and densities, variables related to general living conditions, and finally, attitudinal measures. Also, three specific levels of crowding were deemed to be important in the study. They included crowding perceptions at the house, neighborhood and city levels of analysis.

The project was divided into three sub-areas of study. The major substudy was primarily concerned with the finding of psychological aspects of urban crowding. Specifically, efforts were directed at finding situational, attitudinal and physical determinants of an individual's perception of environmental crowdedness. A sampling technique was developed that integrated important techniques of demography, geography and the normal social research methods of cluster and stratification sampling. Attempts were made to obtain amply surveys from men and women, working and non-working people, and primary ethnic groups composing the area population. An 83-item questionnaire was developed containing a wide variety of questions concerned with substantive aspects of the three variable classes. It was administered to 697 residents living within the San Bernardino/Riverside, California area. The obtained responses were analyzed utilizing multiple regression and correlational techniques. It was found that the perceptions of crowding for the different levels of analysis were, for the most part, independent. Although intercorrelations were significant they were generally weak (r=.18 and r=.13 for house-neighborhood and house-city comparisons respectively; r=.33 for neighborhood-city comparison). In addition, physical measures and densities became progressively less important as one moved from the house to the city level of concern. Conversely, situational and attitudinal variables increased in importance as one moved from the house to the city level of analysis. Combinationally, a total of 34% of the variance could be accounted for at the house level, 35.4% at the neighborhood level, and 40% at the city level by using all of the three classes of variables in an optimal regression fashion. Perceptions of crowding at the three levels of analysis, however, proved to be only weakly related to an individual's attitudes concerning aspects of overpopulation and accounted for only between 5% - 9% of the variance in the attitude.

A second substudy involved the planning-related aspects of density and the priorities for urban amenities that were linked theoretically to the situational variables of the psychology substudy. Library research and interviews with local urban planners led to the conclusion that, although local density planning was ideally guided by the City's general plan (a formulated document that, among other things, sets out provisions for zoning considerations and open space area placement), often these guidelines were disregarded or violated by yielding to pressures from persistent or powerful developers and the political decisions of local city and county officials.

Two additional portions of ths study were completed. Questionnaires were administered to a stratified sample of 103 residents of San Bernardino and Riverside containing a list of 20 urban amenities. Respondents were asked to indicate how much they would be willing to pay for them. Importance responses were factor analyzed and four interpretable themes emerged. They dealt with the convenient location of services, residential areas unencumbered by urban problems, prevalence of vegetation, and a category dealing with pavement. Responses to the importance and value responses were correlated and 15 of the 20 items produced values of .60 or greater, indicating a strong association between importance and willingness to pay. A sample of 17 urban planners were drawn. The respondents in this sample were required to fill out the amenities importance questionnaire completed by the resident sample in two ways. First, they were asked to respond in a manner consistent with their professional role of planner. The were then asked to respond as they felt the average citizen would. A T-test comparison of the two response sets of the planners and those of the residents was made. The results indicated that planners responding as planners differed significantly on only three of the total of the twenty amenities from the ratings of the citizens. Furthermore, analysis indicated that they were aware of this difference. Planners responding as citizens misperceived citizen preference on only two items, slightly overrating the importance of well-paved sidewalks and underestimating the importance of racially balanced neighborhoods. Generally, citizens felt that quiet residential areas unencumbered by urban related problems were important. Although planners, for the most part, agreed with this, they felt that convenience-related services were also needed. A second investigation concerning urban amenities, however, indicated that preference could significantly be linked to the sex, age, race, education, and income characteristics of the respondent. In short, the specific situation of the individual can be related to a statement of preference.

A final portion of the study dealt with economic considerations, as they related to the perception of crowding. Initial attempts at obtaining data from local governmental agencies, with a view to associating per capita costs for services in an area with the population density were frustrated by the inadequate record keeping practices of the offices. Utilization of census data in multiple regression and correlational analysis relating housing and economic characteristics of an area to physical densities provided negative results. Finally, consumer spending behavior, as indicated by an estimation of the percentage of income spent on different budget categories, appeared to be unrelated to the individual's perception of crowding at any of the three levels of analysis.

A computer simulation program was developed for the purpose of predicting trends over time given the indicated relationships. However, implementation of the program was delayed due to the failure of the physical and economic predictors to be related in a substantial way to perceptions of crowding. Reference copy: Library of the University of California, Riverside

****

Social-Environmental Audit of Colorado Springs, Colorado

(Grant no. GY-11426)

Colorado College
Colorado Springs, Colorado 80903

June 10, 1974 - August 17, 1974

Participants:

William D. Eberle	Marianne V. Moore
Hugh D. Heisler	Christopher L. Patton
Elizabeth A. Heller	Susan M. Schoder
Randy D. Huwa	Edward F. Seaton
John L. Kessel*	Wendy A. Stahl
Louie V. Larimer, Jr.	Ellen L. Watson

*Student Project Director

Walter E. Hecox, Faculty Advisor

Twelve students from diverse backgrounds and academic interests attempted to assess the "quality of life" (QOL) of Colorado Springs, Colorado during the summer of 1974. Utilizing a social-environmental audit approach, the students specifically attempted to: 1) develop a standard methodology and framework of "factors" to describe the QOL in Colorado Springs that would provide a macro-view of life in the area, as well as lend itself to annual reporting; 2) provide a quantitative estimate of the changes in community conditions over time; and 3) present the findings in a form useful to a host of user groups.

The initial weeks of the project were devoted to reviewing the available QOL literature. The conclusions which emerged from the review were that: 1) there was no immediate prospect of a breakthrough in achieving a single numerical (index) rating which could incorporate the total comprehensive QOL; and 2) current attempts which define the QOL merely through lists of separately described factors do not demonstrate factor interrelations or trade-offs necessary for a more holistic approach or overall index approach.

With this in mind, the following design was created for determining the QOL in the Colorado Springs urban area.

Social-Environmental Audit

Physical Environment	Socio-Political Environment	Economic/Demographic Environment	Perspective Environment
air	health	labor force composition	public opinion
water	public safety & justice	quality of employment life	attitudes
noise	education	income	
aesthetics	political participation	business climate	
housing	welfare	economic structure	
transportation	culture	demographic	
utilities	recreation		
zoning			

Essentially, the QOL of Colorado Springs was structured into four environments: Physical, Socio-Political, Economic/Demographic, and Perceptive. Under each environment are factors which the group felt significantly contributed to its status. One should note, however, that some factors may, in reality, influence other environments as well. For example, housing is a Socio-Political problem as well as a Physical one. For simplicity the factors were placed under the environment where they could adequately and best be integrated.

The most important rationale for this design was the fact that the structure rendered itself much more readily to an overall description of the QOL than did the standard approach of investigating several unrelated factors. By grouping the factors into four identifiable environments, qualitative integration was possible and some macro-statements regarding the condition of each environment resulted.

In addition to the literature review, the initial weeks of the project were devoted to the development of a potentially applicable set of social indicators which could adequately reflect the status of each factor. These indicators were then reviewed with a broad range of community groups and leaders to insure inclusion only of those which could feasibly and reliably quantify community conditions. The remaining weeks of the project were devoted to the collection, aggregation and analysis of data for these factors.

This effort culminated in a detailed description of community conditions in the urbanized area. Although too numerous to elaborate completely here, the findings suggest that a typical resident of Colorado Springs is willing to endure a low wage scale, an unsatisfactory welfare program, a deficient public transportation system, a high crime rate, and slightly lower mental and physical health conditions in exchange for the climate, aesthetics, and recreation benefits offered by the region and the city. Although the drawbacks of living in Colorado Springs appear quite numerous, this "Socio-Environmental Audit" shows that such deficient areas are counterbalanced by adequate water, air, housing, health care, education, and business climate conditions.

Analysis of the environments clearly indicates that the Socio-Political and Economic/Demographic Environments contain more areas of needed improvement that do the other two Environments. According to the Perceptive public opinion survey, residents feel the most pressing problem areas within these Environments are: crime control, growth, over-population, and economic difficulties. Surprisingly, the Physical Environment, which is rapidly deteriorating in many American cities, appears to be stable in Colorado Springs. Considering all four Environments, this audit indicates that the quality of life for Colorado Springs residents can be rated "fair" with a number of "good" aspects counterbalancing those conditions which detract from the well-being of the area's constituency.

In addition, the audit yielded the following recommendations for improved data collection. First, to achieve comparability the physical area for which data is collected must be standardized. Second, data should be collected at regular intervals so that periodic time-series comparisons can be made. Third, the definitions and criteria used in data collection should be standardized and consistent with federal and state governmental agencies. Finally, the nature of social indicators and the yearly information needed to perform an audit demands a permanent local data collection agency.

If these suggestions are followed, new possibilities will exist for the continued social auditing of Colorado Springs and other cities. The existence of a standardized body of data, collected at regular time intervals with components selected for their informative importance, can facilitate the analysis of correlations among factors and environments. This potential for analysis is a major feature of QOL audits; it is a means for determining causalities and trade-offs, as well as for monitoring social trends. When such analysis is possible, this "Social-Environmental Audit" will become an effective tool both for program evaluation and anticipatory planning.

Reference copy: Tutt Library, Colorado College.

****

Interdisciplinary Application and Expansion of the Urban Dynamics Approach to Manchester, New Hampshire (Grant no. GY-11464)

New Hampshire College
Manchester, New Hampshire 03101

June 2, 1974 - August 24, 1974

Participants:

John Ackerman
Carol Auster
Nick Brattan
Bruce Calhoun
Thomas Dionisio*
Robin Dowling
David Hubbs
Thomas Kelleher
Karen Kushner

*Student Project Director

William A. Hunzeker, Faculty Advisor

The objective of this study was to apply the urban dynamics computer simulation model to the city of Manchester, New Hampshire. Urban dynamics was designed to aid the urban analyst in planning alternative policy decisions so as to assist the intuitive decision making process, and to help avoid counterintuitive behavior of the urban system.

The first phase of the project was to develop a total understanding of systems dynamics methodology and the urban dynamics model. This was accomplished through the use of urban dynamics exercises. These exercises portray the theory and thinking behind urban dynamics.

Phase II was a validation of the urban dynamics model for Manchester. For purposes of urban dynamics, validation can be described as matching the growth curve generated by the model to the actual growth curve of the city. The validation process for Manchester required the alternation of nine data points and three table functions, to cause the model's growth curve to match the actual growth curve of Manchester. The validation process also required the use of a modified version of the urban dynamics model, developed by the M.I.T. Systems Dynamics group. At this point, the model is capable of testing policy and planning tactics.

The urban dynamics model is experimental, and was developed for the sole purpose of making projections to aid the urban analyst in judging the relative trade-offs of policy alternatives. The model is a helpful and useful tool, provided its limitations are realized and understood.

Several policy runs have been made for Manchester city officials. The runs produced favorable results which have made city officials receptive to the model and to the project's findings.

Reference copy: New Hampshire College Library

****

Hitchhiking--A Viable Addition to a Multimodal Transportation System? (Grant no. GY-11486)

University of Colorado at Denver
Denver, Colorado 80203

June 3, 1974 - August 27, 1974

Participants:

Elizabeth P. Andrews	Charles W. Hall
Kemery S. Baldwin	Alfred C. Hamburg
John W. Claydon	Yee Leung
Kenneth E. Dallmeyer*	John D. Martin
Candida M. Deluixe	Gale A. Norton
Carolyn L. Frank	John H. Panzer

Terrell J. Shippy

*Student Project Director

Vasant H. Surti, Faculty Advisor

The present research is a study of the practice of hitchhiking in the United States. It develops social, legal and planning data which dispel many myths and suggest some forms that attack the real problems. The study consisted of library research, interviews with public officials, and four surveys.

The key to the project was the general survey, 195 interviews of people selected in a random representative basis from the urbanized part of the Denver SMSA. Data were obtained on the percentage of current hitchhikers (19%) and drivers who pick up hitchhikers (31%), the percent who ever hitchhiked or picked up hitchhikers (43%; 52%), social characteristics, crime statistics, ways of hitchhiking, opinions on the legal status of hitchhiking, and possible participation if certain reforms were made.

This survey was supplemented by a study of police patrolmen, in depth interviews of current hitchhikers, and a survey of participants in the Fort Collins (Colorado) Community Car Pool, a prototype hitchhiking system.

Fear of crime and traffic safety (accidents) are the two major problems that inhibit a large portion of the public from hitchhiking or from picking up hitchhikers. Other less important reasons are inconvenience, the inbred feeling that it shouldn't be done, and the fear of arrest.

It was concluded that hitchhiking should be legal, because a prohibition is impossible to enforce fairly, and equally, and economically and because the problems involved are not so serious as to incur criminal penalties.

To lower the significance of crime, it is recommended that hitchhikers be registered with a public agency. This should be voluntary. A registered hitchhiker would be more attractive to a potential driver and would stand a better chance of getting a ride. It is not recommended that drivers who pick up hitchhikers be registered, since they are already registered and the act of re-registering would be of further inconvenience.

To improve traffic safety and to provide convenience for both the hitchhiker and potential driver, it is recommended that designated hitchhiking areas be established along streets and highways in places where a car can safely stop.

Whether there would be a sufficient increase in hitchhiking and a sufficient broadening of the kinds of people who would engage in it to justify the expenditures for these reforms is not entirely clear. The surveys indicate, however, that there would be a significant increase in this practice. Reference copy: Center for Urban Transportation Studies, University of Colorado at Denver

* * *

Citizen-Community Interaction in Flagstaff, Arizona (Grant no. GY-11524)

Northern Arizona University
Flagstaff, Arizona 86001

June 1, 1974 - August 28, 1974

Participants:

Charlotte Beyal
Richard Blake
Lynn Fletcher
Mindy Gatlin
Frank Gomez

Patricia Kaske
Brian Pearson*
Susan Veblen
Craig Whitney
Patricia Wing

*Student Project Director

Keith L. Pearson, Faculty Advisor

Studies of the effectiveness of community or social service agencies are usually made from the point of view of the agency. This present study took a different approach, however. Based on the assumption that the effectiveness of social service agencies is dependent upon successful communication with the people the agencies serve, this study was performed to determine the residents' awareness of the agencies available to them.

Flagstaff, Arizona, with a 1974 population of about 31,000, has a large number of agencies and organizations specifically associated with social service activities. Respondents in this research project identified 288 specific agencies and general agency categories, such as churches and fraternities.

There appear to be several reasons for the proliferation of such organizations in Flagstaff. One is that this city is the center for Federal, state and county activities concerned with the surrounding rural population. Another is its proximity to the Navajo and Hopi Indian reservations. Flagstaff also has a great percentage of ethnic minorities, who are generally low-income, less well educated and hold more unskilled jobs than the Caucasian population. This Caucasian community is quite the opposite of its minority "neighbors" and as such, usually tends to initiate, support or run social service agencies for other ethnic groups.

For the purposes of this study, the participants assumed that social service agencies generally focus on people with lower-than-average incomes and educations, and with unskilled jobs. Mexican-American, Black, American-Indian or other non-Caucasian ethnic identities were considered most likely to fit this description.

Further, the participants assumed that social service agency awareness is positively associated with such factors as amount of education, use of formal media, extent of organizational membership, length of Flagstaff residency, familiarity with the city, and the relevance of an agency for a specific ethnic group.

The research program, designed to test hypotheses derived from these assumptions, was based on a random population sample created from census data, city residential address lists and tax assessment information. The study used a partially "open-ended" questionnaire to gather empirical data from residents of 894 housing units.

The first hypothesis contended that ethnic minority people in Flagstaff would be more familiar with social service agencies than were Caucasians. The opposite was found to be true. Mexican-Americans, Blacks and American-Indians knew of fewer agencies than did whites.

The second assumption, which stipulated that there would be a positive association between length of city residence and awareness of social service agencies, was not valid. People who had lived in Flagstaff for a period of 5 to 10 years knew of more agencies than either newer or older city residents.

In the third hypothesis, it was reasoned that persons with a better than average education would be able to identify a greater than average number of agencies. This was strongly supported by the data.

The fourth supposition dealt with the role that the media play in disseminating information about social service agencies. That role was shown to be negligible. Only 25%

of the research population credited formal media with their knowledge of agencies.

The fifth hypothesis, that people who are familiar with the city are also familiar with social service agencies, was supported by the data.

The results of testing the sixth assumption demonstrated that people who belong to several volunteer organizations or clubs also knew of more agencies than those who do not belong to such organizations.

The seventh hypothesis, which maintained that agencies which directed services primarily to people in minority ethnic groups would be known best by those identifications, was strongly supported by the data.

Interpretations of the data reveal that the people who are most likely to be aware of Flagstaff social service agencies are not the people who might be expected to need them the most. Instead, the people who identified the greatest number of agencies had an above-average education and income, were very familiar with the city, belonged to several social clubs and were not associated with any specific ethnic minority.

Analysis of the data strongly indicates that people learn of social agencies primarily from informal sources: family, friends, social clubs, etc. The people of middle or upper socio-economic and educational levels, who support or run these agencies are the people who are aware of the greatest number of them.
Reference copy: University Library of Northern Arizona University

****

Alternative Futures for San Diego (Grant no. GY-11422)

University of California at San Diego
La Jolla, California 92037

June 24, 1974 - September 24, 1974

Participants:

Joseph Caporaletti

Annelese Capteina

George McCollister

Leik Myrabo

Kristen Sellgren

Anthony Stanonik

Susan Szalinski

Thomas Webster*

Michael Zyda

*Student Project Director

Non-Stipend Participants:

Barry Carlton

Thomas Richard

Kent R. Wilson, Faculty Advisor

The goal of this project was to help both regional planners and citizens in general visualize the alternatives for the future of the City of San Diego. Contemporary approaches to this goal are hindered by the enormous complexity of the interactions among the constituents of a regional system. Often, the format of the available information is neither interesting nor understandable to the public or it is out of date before publication.

This study, therefore, was concerned with developing a comprehensive, rapid and easy way of conveying planning data in a form visible to citizens and planners. We did this 1) by making a film for public viewing; and 2) by developing the beginnings of an interactive graphics urban modeling system.

First, research was carried out on the history of San Diego's growth, on current growth trends and urban planning efforts, and on the city's alternative futures. Particularly helpful was the Comprehensive Planning Organization of San Diego (CPO), the area's "council of governments" -- an organization engaged in developing plans for the future of the region through the study of several alternative transportation and land development concepts.

From this research we found that the alternative futures for San Diego currently being studied by local groups are oriented to the question of growth. The options appear to be: 1) a continuation of today's land development trends and reliance on the automobile - a course many feel will turn the city into another Los Angeles; 2) slow or non-growth -- an alternative apparently complicated by legal and other problems; and 3) a broad range of controlled growth strategies, including use of rapid transit and densification of existing urban areas. These last types of growth channeling proposals receive the highest vote of confidence from planners.

One method for choosing among such possibilities involved feeding the alternatives into an urban model as CPO did to obtain some reasonably objective opinions about its consequences. Since planning is a political process, the decision in the end is made by the citizens, so good ways must be found of communicating this information.

The second step in the project, then, was to convey the available information about the city, its problems, planning, and alternative futures to the citizens, enabling them to take a more positive role in determining its future.

This was best accomplished by making a one-half hour film on the city, using San Diego as an example. It portrays the city's growth, current development trends, alternative futures, planning and the involvement of the individual in determining the future. As of December, 1974, a rough draft of the film was complete and the narration was about to be added. We plan to air it on a local television station in the spring.

A third major part of the project was the development of a spatial data base conversion, manipulation and graphical display package. The system takes information in the form of polygens, the most common type of spatial data base and converts it to a grid system, a much more useful and convenient representation for modeling and graphics. A dynamic data display program was written for an Evans and Sutherland Picture System which allowed us to view it in color and stereo data changing in three dimensions as a function of time.

Much system software was developed for this graphics computer including an interface to BASIC and the start of a graphics language compiler. A motion picture camera interface was also built to allow program controlled camera operation. This software package was then used to convert the CPO polygon data to a grid keyed to California State Plane Coordinates (although the software is general enough for application to any polygon and grid system). Grid representations were constructed of many variables such as population and land-use for the alternative futures of a 20-year period up to 1995.

Another section of our project dealt with computerized urban modeling. We improved an air quality model, SDAIR, developed by an SOS group about a year ago to compute the approximate effects of land use and transportation alternatives on air quality. A much improved calibration was added and the programs were packaged for easier use. In addition, we made an analysis of the CPO alternatives using this model.

Together with energy experts at UCSD, a computer model for the prediction of San Diego energy demand up to 1995 was also developed. Grids produced by the spatial data software can be used by the model to predict energy demand for transportation, residential, commercial, industrial and electrical utilities sectors. These, then, combine to give total energy consumption.

The output of these two models and the converted CPO data, all in grid form, can be used to produce dynamic pictures of San Diego's future rapidly and easily.

These accomplishments form the basis for an interactive graphics urban modeling system. As now established, it is essentially an urban information conversion, manipulation and display system. A user can quickly and easily convert polygon data to grid data and view the information. Since this software is completely general, it can be used for any city.

We are now in the process of making the energy model and the display routines entirely interactive and adapting SDAIR for more interactive use.

Construction of a completely interactive urban modeling system will require the incorporation of programs and the development of good-man machine interface routines. This would allow "participatory planning", in which not only planners but citizens and city administrators untrained in the details of computerized urban modeling could interact with a model of the city for the purpose of developing and testing alternative future strategies.

Reference copy: Science and Engineering Library, University of California at San Diego.

****

The Energy Crisis and Decision-Making in the Family (Grant no. GY-11543)

CUNY - Herbert H. Lehman College
Bronx, New York 10468

June 17, 1974 - September 3, 1974

Participants:

Luis Barrera
Jay Brophy
Richard Chen
Jane Cooper
Denise Drosnick
Lisa Esposito
Kevin Harold
Ben Katz
Rovena Kilkeary*
Iris Weissman
Rita Wiseman

*Student Project Director

Patricia Thompson, Faculty Advisor

This exploratory study was designed to obtain information about family use of energy. Two communities were studied in the Queens and Bronx sections of New York City in the summer of 1974. The Queens community had experienced an extended power failure the previous summer while the Bronx community had not. A questionnaire was devised to determine whether exposure to such a crisis situation resulted in different energy consumption practices by families in the two communities.

The questionnaire recorded family characteristics, as well as the respondent's energy knowledge (Energy Knowledge Inventory or "EKI") and the respondent's actual practices (Changed Practices Inventory or "CPI"). In combination these were considered to be indicators of energy conservation.

Ten variables were examined for their relationship to energy conservation practices. They were (1) exposure to extended power blackouts; (2) direct payment of utility bills; (3) family car ownership; (4) belief that concerted effective energy use of all families in the United States can influence the energy crisis;(5) family income;(6) educational level attainment;(7) family composition; (8) age; (9) sex; and (10) purchase of a major household appliance in the year previous to the survey.

Positive relationships were established between the ten variables and energy conservation. Four factors (car ownership, income, educational level attainment, and family composition) were found to relate positively with Energy Knowledge Inventory scores.

Six factors (exposure to extended blackouts, direct payment of utility bills, car ownership, belief in family effort, income, and family composition) related positively to scores on the Changed Practices Inventory.

This study indicates that the strongest influence on energy use is the pocketbook. Moderate income consumers are already striving to be energy-saving, while consumers who can afford to pay higher fuel bills do not change their energy use practices. This study suggests that efforts must be made to induce affluent, well-educated consumers to practice energy conservation. It is proposed that this be done by introducing opportunities to learn energy-saving practices, as well as receiving energy-saving knowledge, in courses in home management.

Reference copy: Herbert H. Lehman College Library.

****

The Feasibility of Self-Sufficiency in Consumption of Energy for a Rural College (Grant no. GY-11443)

Marlboro College
Marlboro, Vermont 05344

Participants:

Nanda Fleming
Kenneth MacLeish
Edward Nelbach
John Nevins
Leonard Slosky
Douglas Smith
James Stiles*
Ingrid Wendt

*Student Project Direct

John Hayes, Faculty Advisor

The purpose of this study was to determine the feasibility of employing those alternate energy sources found on the college property as the sole energy source for the school. To do this required little original research, as a great deal has been and is being done with alternate energy resources. Most of the time was spent in literature surveys at several large libraries and in communicating with people doing research and with experience with alternate energy technologies. The information collected was examined for its applicability to the situation at Marlboro College.

Data collection was the second major portion of the work. A large body of data was needed to determine the applicability of information collected to the college's problem. A very wide range of collection techniques was employed, including correspondence with the National Weather Bureau, interviewing local residents, conducting an experimental type of forest survey, taking measurements of the college plant, and many others. A great deal of computer work was done by the participants when analyzing data.

The conclusions are as follows:

Economics - the prices of heat and electricity will rise, most likely at about 4% above the rate of inflation;

Energy conservation - reducing electrical demand by 20% and heating demand by 30% should be achievable goals for the college;

[illegible]d - holds little promise for the college at present due to its high cost and the lack of a prime wind power site, although future feasibility cannot be ruled out;

Flowing water - due to its size and distribution, this resource holds virtually no promise for the college.

Reference copy: Rice Library, Marlboro College

****

Community Attitudes and the Alcoholic Stereotype (Grant no. GY-11452)

Columbus College
Columbus, Georgia 31907

June 17, 1974 - August 30, 1974

Participants:

Paul Bradley	Judith Opp
James Dixon	Leslie Parker
Nancy Gober	Carol Pearson*
Laura Greer	Richard Roarabaugh
Bob Hight	Billy Snipes
Mary K. Miller	Leonhard Zurawskyj

*Student Project Director

Arnold Powell, Faculty Advisor

The image of the alcoholic and alcoholism is being "stereotyped" by both the medical profession and the public. This notion of alcoholism is causing serious consequences for the diagnosis and treatment of alcoholism. There is need for improvement in theoretical formulations about alcoholism. Likewise, a change in attitude towards the alcoholic is necessary if the problem drinker is to get proper treatment. There is apparent agreement that more emphasis be placed on the individual alcoholic and his problems. But the problem currently at hand is the question of the actual concept of the alcoholic held by public opinion. A community survey of attitudes and opinions toward alcoholics and their characteristics was conducted. The survey investigated the effects of socio-economic status, religious beliefs, parental drinking habits, and personality factors on the respondents' attitude toward problem drinkers, what causes alcoholism, and its treatment and control An existing questionnaire was modified and utilized for this survey. The subjects were 500 randomly selected residents of Columbus, Georgia. These subjects were thought to be an accurate representation of the population of Columbus as designated by census tracts. Of the 500 samples gathered, only 346 were utilized for analysis. Chi-square (X^2) analysis was utililized. A total of twenty-two X^2 analyses were evaluated. The overall results showed that regardless of socio-economic status, religious index, parental drinking habits and personality factors, there was found to be an overwhelming tendency to stereotype. The results of the survey do clearly indicate that stereotyping is prevalent at the public level. Although some differences did occur, they were of no significance to the overall findings. The results of this study indicate a need for change in attitudes toward alcoholism and the alcoholic. The recent increase in anti-alcoholism campaigns need carefuly scrutiny.

Reference copy: Columbus College Library

****

An Environmental Analysis of the Neshota River Park for Recreational Land-Use Planning (Grant no. GY-11446)

University of Wisconsin - Green Bay
Green Bay, Wisconsin 54305

June 3, 1974 - August 18, 1974

Participants:

Carol A. Badwey
James E. Casperson
Jay F. Conta
John R. Dorney*
Maurice L. Keesler
Lorna N[illegible]wve

*Student Project Director

Robert S. Cook Faculty Advisor

Neshota River Park is an important historical site in Brown County, Wisconsin. Logging of the large white pine on the site began in the 1850's and the park was the location of a full-scale logging camp, as well as a logging dam across the Neshota River. Remnants of this activity, the Spillway Pond and part of the old dam structure, are the only vestiges to be found in the area. The park area has been quarried for gravel and then grazed by cattle until it was purchased.

The Neshota River itself is an old glacial spillway and there are several deep, narrow ravines in the park that are heavily forested. The soil in the park is mostly Kewaunee clay on the uplands and Bellevue alluvial silt loam with silt and clay layers along the river's floodplain. The drainageways hold seasonally wet Manawa clays and there are a few organic soil pockets to be found in the park. The vegetation is overwhelmingly deciduous and is primarily second growth aspen or hawthorn pasture. Most of the area is open grassy fields but the largest ravines contain climax sugar maple-basswood forests.

The area contains many song birds and occasional herons and egrets. White-tailed deer roam the park and many smaller mammals, such as skunks and raccons, are common. The water quality in the Neshota River and its main tributary King Creek, both of which flow through the park, is generally poor with high silt loads, high coliform bacteria counts and heavy nutrient loads. The Neshota River has a wide variety of fish including northern pike and carp.

Brown County has an overall scarcity of high quality recreational facilities and the greatest needs are for swimming, picnicking, camping and hiking trail facilities. The park currently contains 220 acres and would be expanded to a total of 490 acres. In 1970, the Brown County Park Commission hired a local landscape architect to make a master plan for the park. This plan called for a 40-80 acre lake using the old logging dam, camping areas, ski hills, numerous shelters and picnic areas, a horse stable, and hiking trails. The total cost in 1974 dollars would have been approximately $1.8 million.

The project's ecological and recreational analyses were used to modify the master plan into an environmentally sound site plan. On the basis of the limnological investigation, the large 40-80 acre lake was determined to be unacceptable in terms of coliform bacteria levels, silt loads and nutrient levels, possibly causing excessive plant algae growth and hazards to health. In its place, a series of seven ponds was recommended for location in the old gravel pits and the river valley and utilized for fishing, swimming and wildlife.

Three separate areas for tent camping, trailer camping and bicycle camping were set up to serve these varied user groups. A system, 9.5 miles long, of hiking, nature and horse riding trails was laid out as well as proposals for easements to increase the total length. A ski hill for toboggans and downhill skiing was proposed with a chalet and rope tows. A 100-foot observation tower which would provide an unequaled view of the entire region was suggested for situation on the hill near the ski area. Seven family picnic areas were established -- each with a wooden summer shelter, along with a separate group picnic area, located near the ski hill, for company and group picnics. An innovative playground is scheduled for the center of the park to provide a play area for the park user's children. Areas for adult games, including softball, tennis and volleyball, were also proposed. A nature/information center would be an added attraction, as well as a wildlife observation platform to permit viewing of the wildlife pond. These will provide needed facilities for nature programs and displays about the park's ecology and human history.

A horse-show ring was planned on the basis of the interest expressed by local horse riding groups. This facility was located where minimal environmental and recreational impact would occur. An old gravel pit would be the site of the parking lot and a wooded berm would be required to screen sights and smells of the ring from nearby sections of the park. If constructed as proposed, the ring will not degrade the park but only provide for another recreational pursuit in the area.

Winter activities would be centered around the ski hill. Cross-country skiing could take place in the picturesque, hilly, east half of the park if snowmobilers were restricted to trails on the western half of the area, near the existing all-weather shelter. Ice skating may be possible on the swimming pond in the center of the park.

A detailed cost analysis was made of this proposed site plan and totaled $1 million with gravel roads and $1.4 million with eventual blacktopping of the roads. Thus, a net savings of $400,000 is realized over the master plan.

The final site plan offers a wide variety of high quality recreational activities, with low environmental damage and at a lower cost than the master plan. The final site plan was completed after several meetings with the Brown County Park Commission and Commissioner, local people, personnel of the Wisconsin Department of Natural Resources, University professors, and the NSF-SOS Study Team. Reference copy: Library, University of Wisconsin - Green Bay.

* * *

Marine Parks in Hawaii (Grant no. GY-11512)

University of Hawaii
Honolulu, Hawaii 96822

June 3, 1974 - August 23, 1974

Participants:

Cynthia Baldwin
James Conomos
Woodrow W. Durbin
Russell D. England
Gilbert P. Kea
William J. Kimmerer*
Cameron McDonald
Michael R. Melton
Stephen J. Morrison
Robert F. Myers
John A. Notch
Randi C. Schneider
Robert F. L. Self
Kirk D. Stephenson
Catherine B. K. Tong

*Student Project Director

S. Arthur Reed, Faculty Advisor

The islands of the Hawaiian chain have seen a rapid growth in human population, a number which is expected to exceed one million by 1980. Because of Hawaii's unique dependence on the sea for food, waste disposal, transportation, and recreation, there is a growing concern about the degradation of its marine environment. With the increase in popularity of fishing, snorkeling, and SCUBA diving, a decline in the abundance of many marine organisms can be expected; although concrete evidence is lacking, discussions with local fishermen and divers indicate that this decline has already been taking place.

One answer to this problem has been the establishment of marine conservation districts and marine sanctuaries. Both of these are areas close to consumption; the difference is that in the former, recreational use is welcomed, while in the latter it is not encouraged. Hawaii has one Marine Sanctuary at Cape Kinau on the island of Maui, and there are two Marine Conservation Districts: Hanauma Bay on Oahu, and Kealakekua Bay on Hawaii. These were established in 1969 in response to public pressure, and were chosen primarily for their location and definability, with less emphasis on the marine biota being protected. These two Marine Conservation Districts are also designated Marine Parks and have been very valuable as recreational resources. Hanauma Bay, for example, receives about 20,000 visitors per month.

The use of a Marine Conservation District as a Marine Park is quite compatible with its conservation purpose. Accordingly, the purpose of this study was to identify those sites on Oahu and Hawaii which would be most suitable for both purposes.

The first question to be answered was: do the people of Hawaii want more marine parks? The answer to this question was approached by two methods on each island: mail questionnaires and interviews at shoreline sites. The questionnaire consisted of a one-page form, accompanied by a stamped, addressed return envelope. It asked the respondent to indicate whether he was in favor of the establishment of more marine parks. Results of the questionnaire are summarized below.

	No. Sent	No. Returned	%	No. Favorable	%
Oahu	1286	545	42	388	71
Hawaii	1500	386	26	272	70

The interview was a ten-minute series of questions asked of users of the shoreline areas. The above question was included in the interview, and these results are summarized below.

	No. Interviews	No. Favorable	%
Oahu	681	463	68
Hawaii	97	67	67

It can be seen that the responses were highly favorable and were statistically the same for the two methods.

The interview and questionnaire methods also attempted to ascertain preferences for sites of new marine parks. The results apparently reflected familiarity with the sites, rather than a comparison of each site with another, and were not used to establish the study sites.

A second aim of the study was to identify the sites for new marine parks. A list of potential park sites was compiled from various sources, including Hawaii and the Sea and discussions with knowledgeable University professors and other scientists. To reduce this list to the three or four sites that could be studied effectively in one summer, consideration was given to the following factors.

Access to the beach from roads
Access to the diving/snorkeling area
Definability of the area for enforcement
Present and planned use of the adjacent land
Proximity to population centers
Exposure to trade winds and heavy surf
Exposure to strong currents

Using these factors as criteria, various sites were compared, several eliminated, and the following study sites chosen:

Hawaii	Oahu
Lapakahi	Kahe Point
Puako	Pupukea
Honaunau	Makapuu
	Kaneohe Bay

On-site surveys to estimate the abundance and diversity of the marine biota were conducted at these locations, and at Hanauma Bay and Kealakekua Bay for comparison. Each site was first surveyed visually to construct maps of the bottom and to determine what kinds of habitats were represented.

Then a series of transects was made of each habitat. A 100-meter line was laid out on the bottom at randomly chosen points. SCUBA divers swam down the line, counting fish within 2.5 meters of the line on either side, and large invertebrates within one meter of the line. Percent coverage of each species of coral and algae, and of substrates, was estimated using a meter-square point quadrant laid at intervals along the line. Visibility was measured, and the strength of currents and surge estimated.

The data collected in the fish transects were used to compute the biomass and abundance of each species and a diversity index. Diversity indices were also calculated for corals and echinoderms. Transects were grouped into the following categories based on substrate and depth:

Coral--*Porites lobata*
Coral--*Porites compressa*
Sand bottom
Shallow reef
Boulders
Ledges
Pavement
Shallow rubble
Deep rubble

Median values for abundance and diversity figures and visibility were computed for each habitat at each site. The values were then compared between sites on each island and between islands.

Coral cover was greatest, as expected, at the Hawaii sites, which are well protected from surf. Coral cover was typically 50-90% over the *Porites lobata* and *Porites compressa* reefs, compared with 30-50% on Oahu for similar reefs. Coral cover was lowest at Pupukea and Makapuu, which are often exposed to heavy surf. As had been expected, there was a higher incidence of sand channels and rubble bottom on Oahu, where the reefs are much older than those on Hawaii.

Abundance of fish was highest over reefs of the finger coral, P. compressa, and significantly higher on Hawaii than on Oahu. Diversity of fish was generally higher on Oahu, particularly in the deep outer edges of the reef where the fish species that are dominant in shallow water are uncommon. More different species were found on Oahu than on Hawaii over the period of study. This can be attributed to the relative constancy of the Hawaii reefs, all of which have been essentially the same structure. The Oahu sites were more diverse in the habitats represented, and could, therefore, be expected to support more different species of fish.

On Hawaii, Lapakahi and Honaunau ranked equal to or better than Kealakekua in abundance and diversity or marine flora and fauna, and superior to Kealakekua in the geographic features previously listed. Accordingly, these sites will be recommended as new marine parks for Hawaii.

On Oahu, every site was superior in some respect to the others, with Makapuu being ranked more consistently high. Because of the inaccessibility of its diving sites and hazardous diving conditions, Makapuu will be listed as a third choice, behind Kahe Point and Pupukea. Kahe Point is comparable to Hanauma Bay in all respects, and has higher coral cover and better accessibility for snorkeling. Pupukea has the highest diversity of fish, with more unique species than any other location. Both sites are more consistent in the abundance and diversity of fish than Hanauma Bay, which has large areas of sand and rubble which support few fish. The Kanehoe Bay patch reefs were not selected because of the poor visibility caused by excessive sediment load and high abundance of phytoplankton.

Reference copy: University of Hawaii Libraries

****

Land Use in the Sawtooth National Recreation Area (Grant no. GY-11525)

College of Idaho
Caldwell, Idaho 83605

June 3, 1974 - August 23, 1974

Participants:

Brian L. Attebery	Michael D. Nowling
James W. Broich	Patricia Ann Saras
James E. Chalfant	Bryan Slinker
Jennifer Ann Eastman	Holly Anne Vaughn
Gerald T. Elliott	Rosalie Ann Wells
Barbara Ertter	Richard N. Williams*

Ronald L. Williams

*Student Project Director

Lyle M. Stanford, Faculty Advisor

The Sawtooth National Recreation Area in Central Idaho was created by Federal legislation in August, 1972. Its purpose is stated in the NRA Act:

> that in order to assure the preservation and protection of the natural, scenic, historic, pastoral and fish and wildlife values and to provide for the

enhancement of the recreational values associated
therewith, the Sawtooth National Recreation Area
is hereby established.

Within the boundaries of the new NRA are settled communities, summer homes, ranches, and camping grounds. To the east and west of the main valley where these habitations are found, lie two large mountain ranges. One of these, the Sawtooths, is classified as a Wilderness Area. If an effective land-use policy can be formulated for the NRA, it could have a broad application across the United States wherever there is interest in preserving the scenic, recreational, historic or other values of a heterogenous site.

To establish an effective base for data collection on a land-use study, the team's efforts were directed along two directions. The first area, largely the biology team's responsibility, was land. The plan was to determine the biological constitution of the Sawtooth NRA. The first month of field work consisted of plant collecting, bird watching, and working with people who were knowledgeable about the area, such as resident miners, ranchers, and Federal biologists.

After the team had achieved a basic understanding of the ecology of the SNRA, it picked two animals, Bighorn Sheep and Greater Sandhill Cranes, both shy and pressure-sensitive animals, to study for the remainder of the project. It was felt that both animals would be good indicator species with respect to human encroachment.

The biology team's second study was oriented towards people. To see what effect people have on the SNRA, three different projects were initiated. The first of these was the Vat Creek Study Area. The Vat Creek Meadow is a marshy meadow which had been drained in 1960 by a series of unsightly ditches to make additional dry grazing ground for domestic sheep. The complexity of this problem eventually brought together all of the various disciplines involved in the project.

The second major project was the water studies program, which traced water quality from early in the year and high in the snow-covered Sawtooths to the end of the tourist season and the major water outflows from the SNRA. Generally, the water quality was very high with some contamination near developed areas.

The last project, an interdisciplinary study, was the trail survey, administered to back-packers in the Sawtooths and White Clouds. Back-packers form a concerned group of individuals most of whom feel that more restrictions and regulations within the nation's wilderness areas are either needed or inevitable.

The folklore team divided its research into two main areas. The first of these involved the extensive collection of the oral history of the Sawtooth Valley region. The team members met with long-term residents of the valley and tape recorded interviews with them, collecting much of the early mining, ranching, and homesteading history of the valley. This recorded history is now on file within the College of Idaho Folklore Archives.

This team's second area of research dealt with measuring and describing many of the log-cabin type structures in the SRNA. Some details of construction were found to be unique to the Sawtooth Valley Region.

The psychology team, through the use of a forced word choice test and questionnaire, was able to discover many of the attitudes of full and part time residents, campers, backpackers and visitors. Introverted attitudes of conservation, preservation, and environmental awareness far outnumbered the more extroverted attitudes of economics and development.

The economic team spent its first weeks gathering past economic data on the SNRA and Custer County (in which the majority of the SNRA is located). Through interpretation and extrapolation of this data, supplemented by interviews with local businessmen, predictions were made for the probable economic future of the Custer County/SNRA region.

During the course of the summer, it had become increasingly apparent that the main values of the Sawtooth National Recreation Area are its water, wildlife and plant life resources, and the mountains themselves as they relate to recreation. Yet, it is man's need for recreation and his many forms of recreation that could constitute the SNRA's biggest enemy in the future. With this in mind, it became obvious that some sort of control over recreational use was needed in this environmentally fragile area, particularly over the Alpine mountain areas and the watersheds.

Reference copy: Terteling Library, College of Idaho

****

Mathematical Modeling of Noise and Air Pollution at Expanding Ontario International Airport (Grant no. GY-11421)

Harvey Mudd College
Claremont, California 91711

June 10, 1974 - August 30, 1974

Participants:

Marlin J. Eller	Gilbert C. Maxey
Susan G. Gordon	James D. Potter*
Thomas L. Harmon	James L. Pringle

J.A. Campbell, Faculty Advisor

Ontario International Airport, located in the Pomona Walnut Valley, east of Los Angeles, plans the construction of a new runway capable of handling jumbo jets, such as 747's and DC-10's. Prior to commencing the building operation, it is required by law that an environmental impact study be performed to determine the magnitude of the effects of such an action upon noise and air pollution in the area. The Northrup Corporation was hired to make this examination, but when the final report was published, local governmental officials were not satisfied. We set as our goals in this project those points which were the subject of discontentment with the Northrup report. We hoped to be able to predict air pollution levels for 1985, taking particular note of the increase in traffic on the San Bernardino Freeway. Also, we planned to construct noise level contours at 5 dBA increments from 85 down to 45 dBA, both of these goals to be accomplished through mathematical modeling and computer simulation.

A computer simulation model for smog production in the region surrounding the airport was constructed. The area used was a rectangle, 11 x 19 miles in size. Having divided the area into one mile square sections and having obtained vehicle counts for all the major roadways from State, county and city officials, we proceeded to compute vehicle miles per day for each of the grid squares. These figures were then converted to parts per million of each of seven automobile exhaust pollutants, using vehicle emission standards, estimated inversion layer height, and an assumption concerning complete and instantaneous mixing throughout the small area.

From Dr. John Seinfeld of the California Institute of Technology, we obtained a most recently devised photochemical reaction mechanism for smog production and some help in constructing the model. We reduced the 39-step mechanism to a system of 19 nonlinear differential equations and proceeded to write computer programs as an attempt to solve the problem. We tried Euler's Method, Trapezoidal Method, Taylor Series, third, fourth, and fifth order explicit Runga-Kutta Methods, Euler-Romberg Method, and Hamming's Predictor Corrector Method; all yielded the same unsatisfactory result. Time increments on the order of .0001 minute were required, thus taking over an hour of computer time to simulate one minute of reaction time. Finally, a third order semi-implicit Runga-Kutta allowed the use of time increments as large as 3 min., thus permitting us to simulate over an hour of reaction time in only a few seconds.

The model operated on the principle of a sample cell of variable dimensions being blown across the valley, from west to east, according to the wind velocity at that particular time of day. The cell would pick up the pollutants emitted by the cars and factories over which it passes, the number of cars varying with time of day and the factories only operating during certain hours. The photochemical reactions would then take place at rates determined by the amount of available sunlight at that time; the cycle was repeated for another time incrementation.

We eliminated all our independent variables, except sunlight, and used it to simulate five different days in the month of June, 1973, comparing our predicted concentrations to those measured hourly at two different air pollution monitoring stations in the simulation area.

Convinced of the model's practical value, we attempted to predict 1985 smog levels for the area, with and without a new runway in operation. Projected population increases for the cities in the area and estimated passenger load increases for the airport for both cases were employed. With the new data plugged into the computer program, we obtained results indicating that there would be only a 0.8% increase in ozone levels (as an extreme value) caused directly by expansion of the airport. This is a very insignificant change and it is felt that there would be no drastic effects on air pollution in the Pomona-Walnut Valley if a new runway were to be constructed at Ontario International Airport.

Our efforts at constructing a computer simulation model for predicting noise contours met with frustration and disappointment. We were able to construct a rather simple model very early in the project, but the type of data that was needed to make it useful were not available.

Reference copy: Norman F. Sprague Memorial Library, Harvey Mudd College

****

Community Design for Optimal Energy and Resource Utilization

(Grant no. GY-11491)

Pennsylvania State University
University Park, Pennsylvania 16801

June 1974 - August 1974

Participants:

Stephen Bilenky*	Bill Klevecka
Valarie Hayes	Vince Manetti

Steve Nearhoff

*Student Project Director

Mark Shaw, Faculty Advisor

A semiautonomus cooperative living unit for 30 people was designed and analyzed with the following goals:

1. Minimize inputs of energy and material resources;
2. Develop on-site renewable and/or recyclable sources of energy, water and materials;
3. Maximize on-site food production;
4. On-site recycling and utilization of organic wastes;
5. Utilization of long-lived and recycled materials in construction.

It was recognized that some degree of lifestyle modification would be necessary to achieve these goals.

The investigation was organized on three levels: 1) developing a preliminary design for a student-faculty, integrated environmental studies center for the Pennsylvania State University; 2) quantification of the energy and resource dynamics of semiautonomous, domestic systems; 3) utilizing the design process as a model to extrapolate some general concepts and factors affecting energy and material resource use.

The small community designed was useful for studying the various ecological, sociological, psychological, and technological aspects of contemporary environmental problems, as they interact in a whole system. A "micro-system", such as used in this design, was found to be very useful for this kind of study. The students and faculty would be living and working in a system where all the interacting factors would be easily apparent in their immediate environment, rather than dispersed throughout some larger system. It would also allow for first-hand practical experience with the everyday tools, skills, technologies, and problems associated with the various aspects of our support systems (shelter, food, energy, waste, social, psychological, etc.).

The domestic services investigated were: shelter and environmental control; food production, processing, storage and consumption; organic wastes system; water; and domestic energy use. The main design goal was to plan these service systems so as to minimize the requirement for outside inputs. The following strategies were utilized to achieve this goal:

1. Design all the services as one functional system so as to maximize multiple-use of resources;
2. Minimize per capita demands on the service systems, while maintaining an adequate living standard;

3. Utilize required resources as efficiently as possible;
4. Satisfy the majority of resource needs from local, renewable and/or recyclable sources;
5. Utilize environmental conditions as an integral part of the system's function and expression.

The design is not presented as the most efficient system possible, but as a model which illustrates some basic dynamics and interactions of the systems utilized, and some of the major factors governing energy and resource utilization.

Shelter - The building as designed and analyzed has a relatively low fuel requirement, (1500 Therms heat loss for the winter season for a 30 person module), but modification in the design and analysis is needed to improve and more completely evaluate the shelter. The best strategy for developing low-energy shelter, is by minimizing operating requirements: reduced space, adapted forms, adequate insulation, minimal internal temperatures, minimal use of complex and energy intensive capital inputs, etc. Utilization of solar space heating systems is restricted by the local climatic conditions. Wood may be a very feasible supply of renewable fuel for this area.

Food - The designed system provides 65% of the community's caloric and 200% of the protein requirements from an area of 7 hectares. The high labor requirements/unit area is low on a per person basis when handled by the total community. Modifications in the production components, i.e., increased utilization of intensive systems (e.g., greenhouse aquaculture), and in the machinery inputs, i.e., intermediate levels of mechanization, are needed to increase the efficiency of the system for all inputs. Attempting to supply contemporary food habits by a semiautonomous system reduces efficiency, and for many foods it would be impractical. Modification of contemporary food habits is needed to achieve higher efficiency, but this need for production efficiency must be balanced with the social and psychological importance of food consumption.

Wastes - Incorporating the organic wastes system with food and energy production makes these wastes into community assets. It also allows the costs of waste treatment to be divided between all the systems. Further investigation is needed on the capital and operating requirements, and sanitary characteristics of the designed system.

Energy and Water Use - The amounts of energy and water the community requires can be significantly reduced by the use of conservation technologies and changes in the members' lifestyles. Utilizing cooperative living to minimize consumption must be balanced with the needs for personal privacy and flexibility.

In general, three basic strategies were utilized to reduce resource requirements: simplification, cooperation, and integration. Initially, resource needs were simplified to reduce the resources required, e.g., reduced space, water and appliance use, simpler diet, etc. Requirements were further reduced by the use of cooperative living arrangements, e.g., common dining, bathing, and laundry facilities, which allows multiple-use of machinery required and reduces duplicated efforts.

Finally, the various service systems (shelter, food, waste, energy, and water) were designed as an integrated system to also maximize multiple and efficient use of resources.

More in-depth study is needed on all aspects of the system. The particular characteristics and performance of each component alone and integrated into a system, need to be investigated. Capital and operating costs, cost/benefit ratios for varying organizational scales and degrees of autonomous operation, flexibility of the system(s) to respond to fluctuating environmental and social conditions and situations, resource and labor requirements resulting from different levels of cooperative activity, etc., also need to be studied.

The main goal in designing a semiautonomous community was not to eliminate the need for industrially produced inputs (obviously, the system as designed could not even be conceived without the availability of many industrially produced materials and technologies), but to develop more efficient ways of utilizing these inputs. The concept of semiautonomy and the strategies utilized to achieve this can be utilized, in modified forms, to help reduce consumption and increase efficiency of resource use in any community.

Attempting to supply domestic resource requirements from local resources, has illustrated the extreme dependence of our present lifestyles on supplies of heretofore inexpensive high quality material and energy resources. It became apparent during the investigations that the evolution of suitable social structures and values needed to accommodate minimum resource consumption lifestyles (whatever their form) is more important and necessary than the physical design of domestic systems.

Reference copy: Pattee Library, Pennsylvania State University

****

Nutrition in Publicly-Supported Institutions (Grant no. GY-11502)

SUNY-State University at Buffalo
Buffalo, New York 14214

September 16, 1974 - November 22, 1974

Participants:

Les Bluestone	Marjorie E. Janowsky
Marjorie J. Cantor	Joanna L. Maier
Leslie M. Cline	Ronald D. Pedersen
Cecelia M. Feit*	Laura J. Strychalski

Jesse R. Townsley

*Student Project Director

Wallace Williams, Faculty Advisor

The rapid rise of food prices is a problem for all consumers. It is especially acute for institutions with residential populations to feed. Our group studied a number of diverse, publicly-supported institutions. The goal was to collect data that enabled us to evaluate the efficiency of their current food service policies. This was accomplished for both the nutritional and economic dimensions.

The group examined the planning of menus, the preparation, distribution, procurement, and wastage of food, as well as the wholesale market in our region. We also inquired into the cultural and behavioral factors that effect the consumption of food by residents of the institutions we studied.

Throughout the study we looked at possible alternative policies and approaches. In addition to economic and nutritional information, we also examined the decision-making and policy-making structures of each institution. The final report includes a thorough analysis of the strengths and weaknesses of each institution. It also includes suggestions for alternate strategies for using the institution's funds more effectively toward the end of good nutrition.

Reference copy: Library, SUNY-State University at Buffalo

****

Benefits of Psychiatric Treatment: Patient, Professional and Community Attitudes (Grant no. GY-11463)

University of Missouri at Kansas City
Kansas City, Missouri 64110

May 15, 1974 - August 15, 1974

Participants:

Nancy E. Downing	William L. Landahl III
John Fasbinder	Deborah L. Regan
Richard M. Gist*	Karen L. Vigliano

Marcia S. Weinstein

*Student Project Director

Non-Stipend Participant:

Mitchell L. Glassman

Bernard Kleinman, Faculty Advisor

This study compared responses of mental health professionals, former psychiatric inpatients discharged "in remission", and members of the community at large to a questionnaire concerning the benefits of various characteristics of psychiatric treatment. The professional sample was stratified across the several clinical disciplines active in mental health care delivery; comparisons were made between these disciplines, as well as within each discipline. Comparisons were also made between these disciplines and the patient group, both by discipline and collectively. Finally, these results were also contrasted with the responses of a randomly chosen sample of the community population. These comparisons were made with computer assistance, both by item mean and by rank order evaluation. An item analysis was conducted to provide specific indices of agreement or divergence for each characteristic.

During the course of the operation of the project, two major problems arose. The first, having to do with the mathematical analysis models, was resolved with the assistance of several members of the University faculty. The second was more serious. The patient group, which constituted the baseline data group for comparative purposes, yielded a much smaller response rate than was originally envisaged. However, a second mailing of the questionnaire provided the needed level of responses.

Reference copy: University of Missouri at Kansas City Library

****

The Study of Revitalization in an Ethnically Diverse Urban Community (Grant no. GY-11456)

Temple University
Philadelphia, Pennsylvania 19122

May - August 1974

Participants:

Mannuel de Alba	Gina Oboler
Juanita Gibson	Leon Oboler
Alan Holden	Elaine Rosenstein
Bruce Johnson	Bill Thompson
Stefan Krotz	Veronica Veerkamp
Ann Malanchuk	John Wasilchick
Arthur Murphy*	Wayne Zachary

Darrell Zimmerman

*Student Project Director

William B. Schwab, Faculty Advisor

Despite the conscious attempt of legislators of the 1960's to include maximum community participation in the implementation of social change in the American city, the failures and controversies characterizing many such attempts at social betterment show that the process is poorly understood. We feel the people of Manayunk have solved one of the major problems facing urban and social planners-- the resolution of the apparent conflict between cultural survival at the local level. It was our interest in finding out how they did it which first led us to this "historic" little community in northwestern Philadelphia.

In addition, we wished to develop the idea of interdisciplinary research in the social sciences and to test the implications of using the computer as a "field tool" to help guide the direction of investigation through early data analysis, rather than as an after-the-fact data reduction device.

Initially, fieldwork began with a demographic, door-to-door survey of Manayunk. The questionnaire used was constructed to gather detailed demographic and economic data and to be compatible with the 1960 and 1970 U.S. census. This was done to permit comparison of our sample with the larger community profile, thus enabling more detailed inferences to be drawn from the census material.

During the survey, members of the research team were drawing up plans for a series of individual studies with the common goal of discovering the essence of Manayunkness. Seven individual studies were conducted during the second phase of the project. In addition, computer programs were written to allow members of the group to make use of Temple University's computer facilities, as befitted their respective investigations. The studies are listed below:

1) We take care of our own. This was a study of the social networks of a group of cooperating families in Manayunk. The data strongly suggest that two major features determine the nature of an individual's effective personal network--territory and kinship. It is a complex working of these two variables in a system of mutual exchange which ensures that the people of Manayunk can take care of their own.

2) Friendship networks among young people in Manayunk. This study dealt with the early development of the territorial networks which are later seen in the adult networks discussed above.

3) Perceptual identities and the analysis of the social relations in peripheral urban environment. It was found that a great degree of similarity existed in ways the identies of "friend," "relative," "acquaintance," and "neighbor" were coded by informants in Manayunk. The significance of similiarity of responses was emphasized by the factor analysis resulting in a three-space which accounted for 81% of the variance. That is, three criteria for answering 60 questions on each of four questionnaries dealing with the four types of people determined most of the answers by 106 informants. The three factors were: the "kinship" factor, accounting for 72.2% of the variance, the "situation interaction" factor, accounting for 6.5% of the variance, and the "trust" factor, accounting for 2.2% of the variance. An opposition between the kinship and situation-interaction factors was hypothesized to be a product of the family-society dichotomy seen in other studies in the project.

4) Interest and ideology: The concepts of ethnicity and religion in a German Catholic Parish of Pennsylvania. This study dealt with the effects of ethnicity and religion in determining the types of relations a group of people are to have with the outside world. The church, with its ethnic parishes, was found to provide an effective vehicle by which groups maintained their identity. Changes toward a homogeneous culture in Manayunk have come about with the elimination of ethnic parishes in favor of territorial ones.

5) Patterns of residence in Manayunk. A study was made to determine whether there was sexual bias in the residence

patterns and kinship networks of husbands and wives in a traditional American working-class community. Questions designed to elicit data on the subject were included in the survey questionnaire administered to 400 families in the community. A definite preference for residence with the wife's kin over the husband's kin was found when families lived non-neolocally. This was accentuated when the wife was of Polish descent. Contrary to expectations from the literature, there was no significant relation between class markers and non-neolocal residence patterns.

6) Socio-geographic boundaries and personal improvement in Manayunk. Working in conjunction with SEPTA (the Southeastern Pensylvania Transit Authority), project members looked at the influences which governed the patterns of travel in and out of Manayunk by its residents. Data indicated that travel for Manayunkers sorted on three dimensions: 1) an inside/outside-the-community dimension, 2) a business/pleasure dimension, and 3) a public/private-transportation dimension. From this and other work done by the team, policy recommendations are being made to SEPTA relative to improving its service to the community.

7) Toward an understanding of conceptions of deviance in Manayunk. Finally, this project investigated those behavior patterns which Manayunkers saw as deviant. Within their block, Manayunkers agreed on who the deviants were. While Manayunkers pointed to public ("street") behaviors thought to be improper when they discussed the deviants, it was found

that certain sociological patterns marked them as separate from the rest of the community. These factors included lower economic status (a number were on welfare), "non-standard" household configurations (e.g., female-headed households), and significantly, no social ties within the community.

While a total discussion of the "Manayunk solution" to bringing different cultures and ethnic groups together for the maintenance of the community will have to await the completion of the second year of study, one clear conclusion should be mentioned. Manayunk is an idea. It is the product of time, during which groups of people through close proximity have developed a meta-culture enabling the various ethnic groups to work together.

Reference copy: Samuel Paley Library, Temple University

****

Indian Community Study: The Elderly Indian (Grant no. GY-11477)

University of Oklahoma
Norman, Oklahoma 73069

June 4, 1974 - August 26, 1974

Participants:

William K. Beard	Charles Muzny
Michael E. Birchall	Anna L. Russell
Steven K. Gugler	Majorie M. Schweitzer
Judy Harrison	Richard A. Searcy
Ann Jordan	Chris Wagner
Joy W. McConnell	Dennis W. Wiedman

Gerry C. Williams *

*Student Project Director

Donald Gordon, Faculty Advisor

The purpose of the study was to assess the role of elderly within the Indian community. Our data show that acculturation and pressure from the dominant Anglo-American society are causing the traditional attitudes toward the aged Indian to change. However, when we view the definition of the aged within the Indian community we find a stress upon the functional aspects of the individual--chronological aspects are secondary guidelines at best. A man or woman is old when they can no longer function; not at age 65.

In terms of the role of the aged we found that the elderly Indian makes or can make a significant contribution. Not only are the elderly valued for their economic contributions to the family, but they are well recognized as being carriers of traditional knowledge and wisdom, and have a high status in the community despite the fact that younger men are beginning to take over roles which were traditionally left to the elderly.

Where traditional institutions exist within the Indian community the elderly have an important role to play. Within the day-to-day experience of "getting by", the elderly are often times an important provider.

We found not a unique community in which the elderly were highly valued, but a community which represents a mixture of the traditional and the contemporary. This community might be summarized as experiencing a multiplicity of pressures which reflect a traditional way of life in the process of change.

Reference copy: University of Oklahoma Library

****

Coordination of Social Services, Information Flow, and the Computer (Grant no. GY-11414)

Michigan State University
East Lansing, Michigan 48823

June 16, 1974 - September 7, 1974

Participants:

William B. Bowman*
Bruce H. Ente
Thomas J. Larkin
Joan C. Richman
Shelley K. Sharp
Shelly L. Smith
James M. Swantek
Erika J. Walton
Rolf T. Wigand

*Student Project Director

Charles F. Wrigley, Faculty Advisor

The rapid proliferation of social service agency bureaucracies in response to critical human problems has raised the serious issue of effective coordination of this multiplicity of ameliorative efforts. Several theoretical approaches to inter-agency organizational analysis have been advanced, but they are unfortunately empirically unvalidated.

The present study explored the implications of communications and information flow for the development of effective mechanisms to coordinate the delivery of classification of information flow patterns among 99 social service agencies in metropolitan Lansing, Michigan. Cluster analysis of organizational variable (V-Analysis) and organizations themselves (O-Analysis) provided another perspective on the structural inter-relationships of these agencies. An empirically-derived group of several organizations was subjected to additional intra-organizational communications network analysis. Cybernetic modelling was employed to simulate the dynamic aspect of the social service agency subset by constructing deterministic sub-models of institutions. Implications of the model were examined in light of the static analyses in order to generate a more effective and efficient system for the coordination of social services delivery.

Reference copy: Library of Michigan State University

****

Expressway Noise Pollution and Its Psychological Effects on Learning (Grant no. GY-11432)

Thomas More College
Covington, Kentucky 41017

May 27, 1974 - August 2, 1974

Participants:

Janette M. Cahill	Paul J. Nienaber*
Christopher L. Gabel	George E. Paptzun
Edward L. Gollar III	Thomas W. Rackers
Robert J. Linz	Charles E. Rolfsen

Mary J. Schmidt

*Student Project Director

George K. Miner, Faculty Advisor

Thomas More College is in a unique situation in that it is near an existing expressway (I-75) and within a half mile of an expressway under construction (I-275). The research group undertook to examine the effects which I-275, at such close proximity to the College, will have on it and the surrounding community.

Properties of expressway noise, as functions of distance and terrain, were examined in terms of decibel levels and frequency content. A standard recording was made so as to have the most even distribution of frequencies. This recording was then played through a filter network to a speaker system. The integrated effects of the varied volume levels and frequency contents were studied in relation to the verbal learning ability of human subjects, using a four-by-four matrix.

It was shown that no correlation exists between sexes; however, a significant correlation was demonstrated between learning ability and age, with younger people having higher learning scores.

Reference copy: Library, Thomas More College

****

The Study of Bilingual Language Acquisition (Grant no. GY-11534)

University of California at Santa Barbara
Santa Barbara, California 93106

June 24, 1974 - September 13, 1974

Participants:

Ellen Liebman*	Susan Peregoy
Kathy Lindholm	Helen Rivas
Suzanne Medina	Felicia Saunders

Jayden Welsh

*Student Project Director

Non-Stipend Participant:

Marie-Therese Coutourier

Amado M. Padilla, Faculty Advisor

Nineteen bilingual (Spanish/English) children were observed over the summer of 1974. Initially, the families of the children were contacted to obtain information about the child and his family. The following information was obtained: 1) child history--birthdate, birthrank, birthplace, schools attended; 2) sibling history--birthplace and birthdates of siblings, language siblings spoke at home, in school, or in public; 3) parent history--birthplace of parents, how many years in the United States, language spoken to child, to siblings, or in public; and 4) language interaction with friends, relatives, mass media. The purpose of this information was to see what patterns helped to promote the development of two languages.

The children were chosen according to the following criteria:

1) The amount of language the child heard in his environment consisted of a ratio of at least two-thirds English to one-third Spanish or two-thirds Spanish to one-third English.

2) The amount of language the child used in his environment consisted of a ratio of at least two-thirds English to one-third Spanish or two-thirds Spanish to one-third English;

3) The children were from families of Mexican descent;

4) The children were verbal enough to converse with strangers both in Spanish and English; and,

5) The children acquired both the English and the Spanish language sometime between the second and seventh year

after birth.

The bilingual children included one two-year old, two two to six-year-olds, three three-year-olds, one three to six-year-old, three four-year-olds, three four to six-year-olds, three children between five and five years, eleven months, and three children between six and six years, eleven months. Although socioeconomic status was not considered in the experimental design, the children were from working class families.

To collect language samples, a group of two experimenters visited the child. One spoke only English and one bilingual (English/Spanish) experimenter spoke only Spanish to the child. By providing toys and conversing with the child, language samples were collected. So that the English language samples could be collected separately from the Spanish language samples, each session was divided into a series of 15-minute blocks. During the first block, only the English speaker interacted with the child, while the Spanish speaker alone interacted with the child during the second block. Each session with the child was tape recorded. A minimum of 400 utterances was collected in each language over a two to six-week period.

Because of the cross-sectional nature of this study, it was not possible to be sensitive to all developmental stages. The children were grouped into four general stages of development. Selective criteria for these stages were based on observation of increasing complexity found in the language samples. The first stage was the least complex, while the fourth stage was the most complex.

The data indicated that the children fell into three groups, according to language dominance. First, the Spanish-dominant children were from homes where the parents were monolingual Spanish speaking. The children's English was learned in preschools or from siblings. The children with no dominance had bilingual parents, as did the children with English dominance.

Reference copy: Library and Institute for Applied Behavioral Science, University of California at Santa Barbara

****

Alternative Planning Strategies in New Town Development

(Grant no. GY-11508)

Northern Illinois University
DeKalb, Illinois 60115

June 17, 1975 - August 23, 1974

Participants:

Noel DeKing*
Thomas Hahn
Martha Hanson
Jess McDonald
Kathy McGuire
Suzanne Mulstein

Thomas Okawara
David Ravenscraft
Dana Rhoads
Steven Share
Marla Utechtt
Dawn Wrobel

*Student Project Director

Charles E. Trott, Faculty Advisor

A recent phenomenon of urbanization has been the surge of interest in a major new communities movement in America. The proponents of new town developments envision a dramatically improved quality of environment, higher levels of services, and superior aesthetic design. This interested culminated in the Title VII portion of the Housing and Urban Development Act of 1970. To what extent, though, are new towns able to alleviate our existing urban problems?

This study examined the planning process of two new towns in order to determine their impact on local communities. The two new towns are Fox Valley East, annexed to the City of Aurora, Illinois, and West Valley, located in Kane County, Illinois. We wanted to establish the degree to which the objectives of the new town developers and the controls exercised through the planning process ameliorate those urban problems that typically result from small-scale independent and uncoordinated developments on urban fringes. Our focus was on four specific problem areas: citizen participation and representation in planning; provision for public services; awareness of engineering constraints posed by the physical environment; and the displacement of existing economic functions. To make our assessments, we interviewed those individuals charged with representing the public interests in the planning process, reviewed public hearings on the proposed new town developments, and applied appropriate models in estimating the demands or impacts of the two developments on the impacted areas and communities.

The implications for the existing components of our urban systems which these new towns will affect diminish the premature enthusiasm which proclaimed them as the solution to our urban problems. The strong political and financial commitment to planning which must precede these grand endeavors did not yet exist in the communities that we studied. Because of the constraints on the planning function, we found that the interests of the private, profit-motivated developer can become dominant if not challenged by either a public-spirited governmental body or an activist community. Reference copy: Davis Hall Map Library, Northern Illinois University

****

The Composition of Two Salt Marshes: Human Impacts, Sociological and Political Implications (Grant no. GY-11545)

SUNY-State University at Stony Brook
Stony Brook, New York 11790

Summer 1974

Participants:

Robert Balcom	David Katz
Sherri Bennett	Teddy Klinghoffer
Jerry Fabrikant	Anna LaFace
Eric Freling	Stuart Levine*
Michael Kaiser	Carl Reisner

*Student Project Director

Non-Stipend Participants:

James Abeles	Robert Davis
Kenneth Broady	Barbara Kopf

Marilyn Levine

Iver Duedall, Faculty Advisor

The two salt marshes that we examined represented two extremes. Flax Pond, located on the north shore of Long Island, is pristine in nature. Pelham Bay, found in the northeast corner of New York City, is heavily impacted. The measurement and explanation of these impacts took the form of an interdisciplinary approach. The natural scientists measured the biochemical impact and its ecological implications. The social scientists measured the human factors which accounted for these differences.

One might ask, "Why study two salt marshes in the first place?" The traditional view was that these were wastelands. Within the last few years, the value of these marshlands, once considered suitable only for gravel mining and as sites for garbage refuse, has been discovered by scientists. They are the most productive farmlands in the world and are valuable food factories for the variety of marine and terrestrial life that inhabit them. They serve as a protective buffer for surrounding lands, absorbing the blows of storm waters and floods. They are natural sewage treatment plants; they clean the tidal waters that ebb and flow within them twice a day.

We wished to account for these biochemical and ecological differences--that is, to determine the human factors that work to either save or destroy a salt marsh.

Flax Pond is located in the suburban Village of Old Field, New York. Old Field's 256 families live in single-family homes on minimum two acre lots. The Village is zoned solely for residential use.

In the early 1960's, an outside developer planned to dredge Flax Pond. He was motivated by a desire for huge profits from sand and gravel mining, as well as an opportunity to use the dredge spoils for filling 18 acres of new residential land. He ran into strong and vocal opposition from the community, which detested any plan to change the salt marsh. Using the dual tactics of legal and political opposition, the residents were able to persuade the State of New York to halt the development of Flax Pond. The State acquired Flax Pond as a field research facility for the State Department of Environmental Conservation and the State University of New York at Stony Brook.

Today, Flax Pond is primarily used for research by these two agencies. Although there is some damage done by motorboats and campers, as well as a potential danger from increased petroleum transportation in Port Jefferson Harbor, three miles to the east, the combination of community pressure and the resultant state acquisition have served to preserve Flax Pond in its natural state.

By contrast, Pelham Bay is located in an urban community in the northeast corner of New York City. The most important social unit in the area is Co-op City, the world's largest housing development. Much of the land around this wetland has been designated as recreational open space as part of Pelham Bay Park. The community is less affluent than its Old Field counterpart, although by no means is is a low-income area.

The marshes of Pelham Bay have been damaged by both pollution and refuse filling. Because the area's sewers handle both sewage and storm runoff, the local pollution treatment plants overflow capacity after a heavy rainfall. After a storm, raw sewage is dumped into the Hutchinson River from a sewage regulator, two miles upstream from our sample sites. Another one-half mile upstream is an additional source of pollution, the oil processing and transfer industry in the Village of Pelham Manor. The amount of pollution in the river is greater than the amount that could possibly flow from the two companies that hold waste dumping permits. Sloppy ship-to-shore oil transfers and unpermitted outfall may be the true source of much of the pollution that finds its way downstream.

In addition to being poisoned, over 380 acres of marshland have been filled with processed garbage by the New York City Department of Sanitation. An additional 300 acres would have been filled, but strong community pressure forced the City to designate the endangered area as a wildlife preserve.

A last threat to the environment is a dredging proposal: an Army Corps of Engineers navigation project which will endanger marshland life.

Clearly the explanation of why one marsh was preserved while the other was not, is very complex. Certainly, the differences between the two marshes is related to the relative strengths of the various groups whose decisions effect the environment at each marsh. At Old Field, a well-to-do, vocal and long-established community, there were enough resources to prevent the destruction of Flax Pond. Pelham Bay, a less affluent, less well established, community resides next to a foul smelling, unattractive marshland. Society must accept the legitimacy of preserving the wetlands, regardless of the wealth and status of the area residents.

We have seen that various societal groups make decisions which determine the use of a resource. In managing the wetlands, these decision-making groups sometimes work at cross purposes. This is evident at Pelham Bay. The Army Corps of Engineers and the upstream oil industry are primarily interested in the development of the Pelham Bay estuary for commerce, a goal which may be completely at odds with New York City's recreational plans (plans which themselves may be in conflict with the decision to designate the marshland for wildlife preservation). The many institutions that govern a salt marsh have separate institutional goals. Is it not logical that each should manage the marshland in ways consistent with these independent goals?

As a larger number of groups influence wetlands management there is an increased chance of misuse and a decreased sense of responsibility of each group. What is needed is the establishment of regional or local planning agencies whose only goal would be the intelligent management of the wetlands within its jurisdiction.

These planning agencies should be free of the political pressures which allow a marsh to be destroyed on the basis of individual power. The members of such agencies, appointed on the basis of their technical expertise, could implement the goals of either preservation or even limited destruction, when absolutely necessary. Such agencies could be held accountable for their actions.

The five biological and physiochemical tests that follow were performed at each site to measure the amount of impact. They were salinity and temperature, biochemical oxygen demand, ammonia concentration, nutrient concentrations, and density of the coliform population.

In the nutrient study, final tabulations showed Pelham's values to be much higher than those found in Flax Pond.

In dealing with the salinities, we were especially interested in the study of the salt marsh as a "washing machine." The reason for this is its reliability in measuring the effectiveness of the salt marsh. This is an important function because of the necessity for mixing of nutrients and keeping the ecological chain unclogged. The changing concentrations of salinity show how effective the flushing mechanism is. In Flax Pond, all but 3% of the water is flushed out at low tide and the variance is great over the tidal cycle, with an equilibration of total salt concentration occurring over the cycle. In Pelham Bay, all but 1% of the water is flushed out, but the salt content shows no real flux pattern thus illustrating the "clogged" flushing mechanism that walls off the marsh from the rest of the system.

The oxygen content, deduced from the test for B.O.D., in Flax Pond was two or three times as high as in Pelham Bay. Flax Pond has a large and varied biomass because of this high level of oxygen. The lower levels at Pelham Bay would hinder the development and growth of many species, but do not totally rule out a fish population. The high photosynthetic activity at Flax Pond provides for a constant replenishment of the oxygen levels. This does not occur at Pelham, where the high respiration levels strip the water of its oxygen.

The net productivity of Flax Pond's waters is strikingly higher than that of Pelham Bay--almost 10 to 12 times higher. Flax Pond seems to be taking large amounts of carbon, which enters the marsh from Long Island Sound, and fixing it during the photosynthetic process. In effect, it is cleaning the waters which flood the pond. This effect is not evident at Pelham, where the productivity rate appears to be relatively constant throughout the tidal cycle.

The respiration rate at Pelham Bay is three to four times that of Flax Pond. This is the result of the higher nutrient level found within Pelham Bay and its surrounding waters. Aerobic organisms break down these nutrients with the use of oxygen. At Flax Pond the production of oxygen far exceeds its breakdown.

We found that the ammonia concentrations in Pelham Bay were ten times higher than those found at Flax Pond. This can be directly correlated to the high concentrations of nutrients and anaerobic respiration occurring in Pelham, as shown by the test for B.O.D. and later confirmed by the bacterial concentrations found. The ammonia concentrations found followed similar fluctuation patterns, as that illustrated by salinity, showing leaching by the spartina clogging the flushing mechanism at work in Pelham.

The last biological study, in addition to a complete survey of the macroscopic benthic organisms of both marshes, was the coliform test. Briefly, the results were a mean value of 70,000 coliform bacteria and 75,000 total bacteria at Pelham Bay as compared to 10 and 26 respectively at Flax Pond. These figures were number of colonies per 100 mls. The median allowable value for recreational water is 700. The fact that the coliform count is directly related to the amount of raw sewage dumping adds significance to this figure.

The ecological analysis is, in essence--How do the previously described parameters affect marine life, its reproductive and food cycles, biomass, and the other relationships in the environment? The biomass of Flax Pond was higher than that of Pelham, showing how impacted the waters of the Bronx are. The normal relationships and cycles occurring in "model" wetlands coincide with our Flax Pond observations, unlike Pelham Bay, which is chiefly anaerobic in nature.

In conclusion, all marshes are important and actions should be taken to protect them. As John Teal said, "From the movement made by animals, it is obvious that the whole complex of coastal marshes is important. Fishes and birds that have evolved depend on finding marshes all along the coast wherever they wander. The preservation of a few marshes here and there will not serve for their existences."

Referency copy: Library, SUNY-State University at Stony Brook

****

National Policies and Local Environmental Problem Solving: Lane County, Oregon (Grant no. GY-11434)

University of Oregon
Eugene, Oregon 97403

Summer 1974

Participants:

Vic Affolter	John Miller
Debra Corbett*	Rosella Miller
Ken Embery	Patricia Mulder
Paul Fitzgerald	Jane Rarita
Ann Galvin	William Street
Nancy Henderson	Richard Worthington

*Student Project Director

Steven Deutsch, Faculty Advisor

Lane County, Oregon is a particularly fertile area for an analysis of the relationships between Federal environmental policies and local environmental problem-solving. The county is located in a state that has a national reputation for the environmental initiatives of its citizens and elected officials. Despite those local initiatives, the policies of the Federal government and multinational corporations often dominate the economy and environment of the county.

Federal lands, which comprise almost 60% of Lane County, produce more than three-fourths of the timber used by the county's economically dominant lumber industry. Over 40% of the county government's revenues come from Federal timber sale receipts. Over three-fourths of those who work in manufacturing are employed in the lumber industry which is very sensitive to Federal monetary policy. With high interest rates, the county's unemployment rate has been hovering around 10% during the last quarter of 1974. The local economy is further depressed by the log export policies of the multinational timber corporations. These problems are compounded by a 32% population increase during the decade of the sixties--one-half of which was due to net immigration. This rapid population growth has provided fierce competition for available jobs, and has encouraged urban sprawl and rural subdivisions which degrade the county's physical environment.

This study presents a mosaic of findings on the values and preferences of local citizens and the process and impact of environmental and economic decision making in Lane County. From urban renewal to Federal land management, from the city council chambers to the Federal bureaucrat's office, citizens are alienated from the decision-making process. Surveys and interviews indicate that these citizens are frustrated by the fact that those forces which have a primary impact on their economy and environment appear to be beyond their control. While significant numbers of the county's citizens do play an active role in the decision-making process, many more believe that they should be involved, yet feel excluded. This is particularly true of the decisions of those Federal agencies that are accustomed to responding to a national constituency or organized economic interests.

Recent and on-going Federal, state, county and city planning processes are innovative to the extent that they are attracting national attention. These processes are examined with particular focus on their facilitation of local initiatives either by direct citizen involvement or by interagency coordination. Tentative conclusions are reached about the consequences of these processes, and suggestions are made for ways in which local citizens can have a greater influence on those decisions which have a significant impact on their lives. Reference copy: Library, University of Oregon.

****

Evaluation of the Effects of Noise from Urban Freeways

(Grant no. GY-11493)

Western Washington State College
Bellingham, Washington 98225

June 15, 1975 - September 15, 1975

Participants:

Bill Aebischer	Mary Ann Hoye
Darryl Bullington*	David Lerner
David Drebin	Doug Repman
Anna Holzmuller	James Tremblay

*Student Project Director

James R. Albers, Faculty Advisor

Three different projects were completed in order to assess the effect of urban freeways upon nearby residents in Bellingham and Seattle, Washington. Following a review of the literature regarding the sources of freeway noise and other attempts to correlate noise exposure with annoyance the following tasks were completed:

1) A social survey was conducted to measure the noise annoyance of residents living near an interstate freeway. The annoyance was then correlated with

the local noise exposure which was determined from 24-hour sound level measurements.

2) An experiment was performed which measured the performance of student volunteers who worked at a task requiring a high degree of verbal communication in a room with several levels of freeway noise.

3) Pure tone conduction tests were performed in the homes of residents who lived near the freeway. The test results were compared with similar hearing tests conducted upon a random U. S. population without background noise.

Freeway noise was measured with a sound level meter in three residential areas in Bellingham, and two residential areas and an apartment building in Seattle. Five measurement sites in each area were located within 130 and 1,050 feet from the center of Interstate 5. Measurements were made hourly at each of these sites for either 17 or 24-hour periods. Readings of the noise levels at each site were converted into noise equivalent levels (L_{eq}), a single measure of noise exposure. Residents were divided into four zones using plots of the noise equivalent level as a function of distance from the freeway. The relative annoyance of residents in the four zones to noise was then compared.

Approximately 550 questionnaires were distributed in six areas of the two cities. These areas were all within three blocks of Interstate 5. Twenty percent of the 235 respondents indicated that they were very bothered by noise. When asked to identify the kinds of noise that were bothersome, residents of both cities were far more annoyed by freeway noise than by that from other sources of noise in their neighborhoods. In Bellingham, 34% of the respondents were either bothered or very bothered by the freeway noise. This compares with 65%

of the respondents in Seattle who indicated that they were bothered or were very bothered by freeway noise.

To determine how noise and annoyance were related, each of the respondents' perceived noise level, as well as the measured noise-distance level, was cross tabulated with questions that probed annoyance to noise. It was found that an individual's own perception of the noise in his neighborhood was a better predictor of his annoyance than was the measured noise exposure in the neighborhood. Furthermore, 32% of the respondents who felt that their neighborhood was noisy or very noisy, disliked living in their neighborhood. Noise is, therefore, a major contributor to an individual's dissatisfaction with the neighborhood. Neither sex, age, socio-economic status, housing tenure, nor perceived sensitivity to noise discriminated between the degree of annoyance when analysis of variance tests were performed on an aggregate annoyance index. Only the noise-distance level resulted in a significant difference between mean annoyance scores, with annoyance being directly proportional to noise and inversely proportional to distance from the freeway.

Thirty pairs of college students participated in an experiment to assess the effect of freeway noise on verbal communication and willingness to persevere at a frustrating task. Subjects first took turns describing designs to their concealed partner who attempted to replicate the designs with colored blocks. Freeway noise was played during the task to simulate noise levels measured in homes near Interstate 5. Ten pairs worked with noise levels at 55 to 70 dB(A), ten worked under 40 to 55 dB(A), and ten worked without freeway noise. No significant difference in the number of verbalizations or in performance was observed between the three test groups.

A second test to measure perseverance was conducted immediately after the communication task in which the subjects were asked to trace four diagrams without lifting their pencil from the paper or drawing over a line. Two diagrams were soluble and two were insoluble. This task was performed either in a quiet room or in a room in which 55 to 70 dB(A) freeway noise was present. Subjects who had performed the first task under moderate and high noise levels worked significantly longer and made more trials than subjects who performed the first task without freeway noise. Freeway noise during the second task did not, however, significantly affect performance.

An audiology study was also carried out to determine whether the ability to hear in homes near an urban freeway was affected by the freeway noise. To measure both the hearing loss that might have occurred from living near the freeway and the masking of the tone by the background noise, tests were performed in homes of the participants. Pure tone conduction tests were performed. While the tests were being conducted, background noise levels were between 40 dB(A) and 56dB(A). Tests were administered to a population of 15 males and six female volunteers living in Bellingham, Washington.

Results of the tests indicated that the hearing of those tested compared closely with a random sampling of the U. S. population who were tested in a similar way without background noise. It is felt that any physiological changes, if they occur due to the noise, could only be found by comparing the rate of hearing loss with a control group and by performing such tests over a period of years.

Reference copy: Western Washington State College Library

****

Planning and Management of Wetlands: Case Study for Middletown, Connecticut (Grant no. GY-11451)

Wesleyan University
Middletown, Connecticut 06457

June 3, 1974 - August 23, 1974

Participants:

Michael Brody
Jeffrey McChristian
Christine McCoy
R. Bruce Paton*
Richard Potter
Harold Sogard
William Wook

(Names of remaining participants not available)

*Student Project Director

Jon A. Rasmussen, Faculty Advisor

The enactment of an "environmental" law has ramifications that cannot all be considered in the political process of making the law. More often than not, dealing with these ramifications is left to local administrative agencies poorly equipped to evaluate the full range of the law's effects. An unusually complex example is Connecticut's Inland Wetlands Act, which requires municipal governments to regulate the use and development of wetlands.

Because of limited funds, State and local agencies have not been able to develop a comprehensive analytical procedure for predicting the demographic, economic and natural resource effects of any chosen policy. Administrative action has been limited to a case-by-case review, rather than the development and utilization of a long-term plan.

The current study explored a range of planning considerations and developed a program of evaluation, which was then applied to an area encompassing several acres of wetland and considerable unregulated land. By applying a wide range of biologic, geologic, economic and political analyses to a model site, the team attempted to illustrate a comprehensive planning approach which would be widely applicable to the problem of wetlands regulation.

Reference copy: Library, Wesleyan University

****

Section IV.

Water-Related Studies

Papers from Franklin and Marshall College, Central Missouri State University, Alcorn State University, Northern Illinois University, California State College at Bakersfield, Benedictine College, Evergreen State College (2), Illinois State University, Texas Lutheran College, Goucher College, Woods Hole Oceanographic Institution, University of Oklahoma, Luther College, Lamar University, Lehigh University, Manhattan College, Loyola University of Chicago, West Virginia Wesleyan College, Western Washington State College, University of West Florida, University of Puerto Rico at Mayaquez, Western Kentucky University, Central University of Iowa, Lowell Technological Institute, Johns Hopkins University, University of Southwestern Louisiana, College of Charleston, Lafayette College, Wright State University, Southwestern at Memphis, Marist College, Brigham Young University and Purdue University.

Environmental Zinc and Plant Toxicity (Grant no. GY-11460)

Franklin & Marshall College
Lancaster, Pennsylvania 17604

June 6, 1974 - August 21, 1974

Participants:

Warren Capps
Mary Enama
Steven Jakubowics
R. Craig Kochel
Judith Rosen*
Kristene Whitmore
Bruce Wicherski

*Student Project Director

Carl S. Pike, Faculty Advisor

Zinc is an essential micronutrient for plants, required in the range of 10 to 300 ppm in the medium. Concentrations substantially above this range can result in the expression of toxicity symptoms. Problem areas exist at sites of natural mineralization, as well as in places where man's activities have increased the environmental zinc level, e.g., near smelters and mines and in sewage sludge and industrial wastes. Nevertheless, the effects of zinc pollution are poorly recognized and understood. This project sought to elucidate certain basic edaphic, physiological, biochemical, and ecological parameters of environmental zinc contamination and toxicity in plants. Detailed soil analyses were performed on samples taken from a corn field located on the site of the abandoned Bamford zinc mine. Data analysis involved mapping and statistical correlation with plant samples obtained from the same site and analyzed for metal content and chlorophyll levels. Physiological and biochemical studies performed on hydroponically-grown plants sought to determine the precise site of the zinc lesion. Sludge studies involved growing garden vegetables on a sample plot. Techniques used included atomic absorption spectrophometry, X-ray diffraction, spectrophotometry, biochemical assay methods, differential centrifugation, radioisotopes, and hydroponic culture techniques. Results are briefly discussed below.

The almost universal symptom of zinc toxicity is chlorosis with symptoms resembling iron deficiency. Iron is known to be a cofactor for at least one step in chlorophyll synthesis. In addition, the literature indicates zinc to be a potent inhibitor of iron absorption and/or translocation in plants. One major hypothesis considered in this project was that, by interfering with iron supply to leaves, zinc could indirectly effect an inhibition of chlorophyll synthesis visibly manifested as chlorosis. This hypothesis was examined in the field and under controlled nutrient conditions in the laboratory. Correlations involved the zinc and iron content of the medium as related to zinc and iron distribution in the plant and physiological parameters of toxicity.

Corn plants on a field adjacent to the abandoned Bamford zinc mine in East Hempfield Township, Lancaster County, Pennsylvania, were chlorotic, severely stunted, and developmentally mature. Plants farthest from the mine appeared normal, healthy, and green. Significant inverse correlations were found between soil zinc and chlorophyll and between leaf zinc and chlorophyll in plants growing on a continuum of soil zinc levels. No trend in soil or leaf iron was seen. In addition, it was noted that the clay minerals chlorite and illite were homogeneous throughout the field, and cation exchange capacity was low. It was, therefore, decided that clay mineralogy did not contribute significantly to the expression or "non-expression" of zinc toxicity. However, pH was determined as a possible factor in the expression of toxicity in a number of isolated chlorotic clumps contained within the green (healthy) area.

When corn was grown hydroponically, significant inverse correlations were found between nutrient zinc and plant iron content as well as chlorophyll content. In addition, it was shown that by increasing the nutrient iron and holding zinc constant at a toxic level one could overcome the toxic response in plants. As nutrient iron increased, root and leaf iron increased at the expense of decreased zinc. Furthermore, chlorophyll levels were positively and significantly correlated with nutrient iron, as well as root and leaf iron. These results suggest that high nutrient zinc induces an iron deficiency by interfering with the uptake and translocation of iron through competition. This effect is then manifested in decreased production of chlorophyll, visible to the observer as iron deficiency chlorosis. It should be noted that this conclusion is further substantiated by subcellular localization studies which indicate that high zinc concentrations lower the iron content of the chloroplast. Also, preliminary porphyrin studies suggest that iron might be required in the conversion of coproporphyrinogen to protoprophyrinogen.

Certain agricultural practices threaten to increase the incidence of zine toxicity problems in the future. Applications of sewage sludge to farmlands (and gardens) has been shown to drastically raise the level of soil zinc. Our studies indicate that application of liquid sludge can increase available zinc in the soil by as much as five times, while solid sludge can increase available zinc more than ten times. Furthermore, accumulation of zinc in the soil was shown to significantly increase zinc levels in the edible portions of a number of garden vegetables, including radish and lettuce. We propose that zinc be seriously considered as an environmental contaminant in the future along with a number of other heavy metals including Cu and Ni. Studies in this area - particularly those concerned with related human health problems - should be encouraged.

Reference copy: Fackenthal Library, Franklin & Marshall College

****

Impact Comparison of Existing and Proposed Sewage Facilities in Two Midwestern Municipalities (Grant no. GY-11462)

Central Missouri State University
Warrensburg, Missouri 64093

June 3, 1974 - August 9, 1974

Participants:

Leva Elaine Aholt*
James Ebun Atolagbe
Mary Lynn Augustine
Cynthia Anne Cleveland
Allen Ray Davis
Alice Andrea Johnson
Denise Randenia Jolly
Linda Joye Milum
Francis Alexander Pettigrew
Randy Jay Wilson

*Student Project Director

John F. Belshe, Faculty Advisor

The City of Warrensburg, Missouri, is served by two sewage plants, each designed to handle 750,000 gallons of sewage per day. Four main objectives were determined for this study.

The primary goal was to determine the efficiency of Warrensburg's two existing plants in relation to their design and operation. In addition, the physical, chemical, and biological status of two streams selected as sites for two new sewage facilities in Warrensburg was determined. This included a partial impact statement concerning the aquatic status, including a fish and macroinvertebrate analysis of Post Oak Creek and Bear Creek at approximate locations of the proposed sewer plants.

The third objective was to compare the efficiency of the existing sewage plants to the efficiency of the existing sewage plant in Lexington, Missouri. Because of a different plant design at Lexington, it was used as a comparison for the Warrensburg plants, since the Lexington plant was found to be operating within its capacity.

The fourth objective was to analyze, assemble and distribute the data to personnel and agencies who would be most capable of utilizing it.

To fulfill these purposes, physico-chemical and biological water quality data were determined for seven stations at the East and the West Sewage Plants in Warrensburg. Samples were taken at the following locations.

1) after the bar screen--influent
2) after the grit chamber
3) after the primary clarifier
4) after the biological trickling filter

5) after the secondary clarifier--effluent
6) 100 yards downstream from the outfall pipe
7) 100 yards upstream from the outfall pipe

The sewage plant at Lexington was a primary plant which emptied directly into the Missouri River. Because of this difference in design, only the influent and effluent samples were taken from the Lexington facility.

The physical parameters measured included flow data, turbidity, water and air temperature, percent cloud cover and settleable solids. The chemical tests performed were pH and reserve pH, alkalinity, carbon dioxide, total phosphates, nitrates, nitrites, detergents, dissolved oxygen and biochemical oxygen demand (BOD). Total coliform and total bacteria comprised the biological analysis on water samples. These tests were performed according to Standard Methods for Water and Wastewater Analysis (American Public Health Association, 1971).

In addition to the efficiency study, the aquatic status of Bear Creek and Post Oak Creek was investigated. Indices of diversity, dominance, evenness, richness and a Shannon index of general diversity were determined for fish collections. A chemical analysis was performed at these sites. The samples taken from these streams were bracketed in order to include the proposed locations for two secondary plants which will be constructed by Warrensburg, utilizing state and Federal funds.

The August 6 meeting of the Lexington City Council was attended by members of the Student Originated Studies group. A report of the summer's work and a discussion of the data and results were presented.

Reference copy: Ward Edwards Library, Central Missouri State University

****

Chemical and Bacterial Water Pollution Indices at Alcorn State University (Grant no. GY-11517)

Alcorn State University
Lorman, Mississippi 39096

June 3, 1974 - August 19, 1974

Participants:

Belvia Carter
Hattie Cole
Charlene Cole
Janice Marion
Ruben Smith*

*Student Project Director

Verna R. Lawson, Faculty Advisor

Three lakes which feed into the ground water contribute to the Alcorn State University drinking water supply. The chemical and bacterial indices of these three lakes were unknown. Since complaints had been made that the pollutant level of these water sources on the campus led directly to health problems of students and faculty, it was necessary to determine if the bacterial and chemical indices of the lakes were of a character and magnitude to warrant concern about pollutant control. A survey of the chemical species and bacterial strains found in Burris Hall Lake, Lake Le Tourneau, and FHA Lake was conducted.

Samples from each of the three lakes were taken daily for a period of 60 days. The number of samples taken from a lake on any one day ranged from five to ten. The samples were taken at many points along the edge of the lakes and at various localities in the interior. Surface samples, as well as samples at various depths below the surface, were taken. The samples were obtained from lake areas which varied in zoo- and phytoplankton, as well as proximity to plant communities at various ecological levels. Samples were taken at points near large deposits of fecal matter and in areas at the edge of the lakes where dogs, cows, and other domestic animals were feeding, drinking and urinating at the time of the sample collection. Sampling was done under various weather conditions, e.g., during a rainfall, and on cloudy and clear days. Samples were taken near floating logs and other debris and in areas free of debris.

Bacteria from the three water sources were isolated on differential media: Staphylococcus Medium No. 110, Pseudomonas Milk Agar, E. M. B. Agar, MacConkey Agar, Endo Agar, Nutrient Agar and Nutrient Broth. The bacteria were subsequently identified using the following biochemical tests: indole methyl red, Voges-Proskauer, Simmons citrate, hydrogen sulfide, urease, gram stain, motility, gelatin, glucose, lactose, sucrose, mannitol, adonitol, fat hydrolysis, starch hydrolysis, nitrate broth, inositol, and litmus milk.

The strains of aerobic bacteria isolated were *Aerobactor aerogenes*, *Pseudomonas polygoni*, *Staphylococcus aureus*, *Escherichia coli*, *Escherichia freundi*, *Streptomyces albus*, *Streptomyces griseolus*, *Salmonella enteridis*, *Alcaligenes vascolactis* and *Bacillus laterosporus*. The two facultative anaerobic bacteria isolated were *Clostridium pectinovorum* and *Clostridium histolyticum*.

Only two bacteria isolated, *Staphylococcus aureus* and *Escherichia coli*,are pathogenic to domestic animals. These bacteria were isolated from water samples taken in areas accessible to domestic animals and near fecal deposits. One bacterium isolated, Pseudomonas polygoni, was a pathogen of bind-weeds, morning-glories, and other running vine growth. This bacterium was isolated from a sample taken from a lake area with a great deal of black bind-weed. Other bacteria isolated from the lakes were normal inhabitants of soil and/or water. The only bacterium isolated which was found in more than one lake was Escherichia coli. This is not to say that this is the only common bacterium present in the three lakes; however, this is the only one isolated from all water samples which was a common inhabitant of two of the three lakes. A further study of the lakes would probably reveal that some of the other bacteria isolated from water samples would be common inhabitants of two or more lakes. The temperature and pH of the water samples, from which bacteria were subsequently isolated, were in the normal range expected for growth of the various bacteria found in the several water samples. All but one bacterium isolated were found in surface samples. The facultative anaerobes were found in samples taken five feet below the surface of the water. No strict anaerobes were isolated from the water samples because of the lack of equipment essential to the isolation of strict anaerobes.

Although two strains of bacteria pathogenic to domestic animals were isolated from Burris Hall Lake and FHA Lake, the quantity of chlorine added to the drinking water supply by the purification system would be sufficient to kill these two organisms. The results of the bacterial analysis do not indicate the presence of the quantity or type of bacteria to warrant concern about health problems resulting from bacterial contamination of the drinking water supply by water from Burris Hall Lake, Lake Le Tourneau, or FHA Lake.

Water samples collected from the three lakes were tested for presence of 11 chemical constituents normally found in bodies of fresh water. Analyses were made to determine if the concentrations of these constituents fell within the recommended ranges for unpolluted waters. Except for measurements of temperature, pH, and absorbance of diffusible light, all tests were performed using specially designed kits obtained from Hach Chemical Company.

Data indicate that the concentrations of ionic species in each of the lakes fall within acceptable limits even though there is a great deal of variation from lake to lake and even from sample to sample from the same lake. Nitrate and ferric ion concentrations were relatively high, but still within the allowed range for fresh waters. Each of the three lakes exhibited a basic quality on the average, although FHA lake registered pH values between six and seven on two of the test days.

Variations in BOD appeared at different sampling spots on the lakes, but these could be readily correlated with depth and with the existence of algal growth at various places on the lakes.

The overall results of the chemical phase of water analysis showed no concentrations of constituents which could be responsible for detrimental health effects reported on campus.
Reference copy: J. D. Boyd Library, Alcorn State University
****

Effects and Possible Improvement of Municipal Storm Sewer Runoff (Grant no. GY-11427)

Northern Illinois University
DeKalb, Illinois 60115

May 28, 1974 - August 17, 1974

Participants:

Gene Bergemann
Judy Bishop
Jack Braun*
Laurie Cannan
Norm Dovicki
John Kerins
John Landgraf
Louis Lipsey
Angelo Rentas
Robert Swick
Laura Unger
C. Robert Wilson

*Student Project Director

James Brower, Faculty Advisor

This study took place in Elgin, Illinois, a city along the shore of the Fox River. The sample storm sewer system drained the Elgin Civic Center Complex and emptied directly into the river.

The purpose of this project was to analyze the pollutants of storm sewer runoff in an urban area, determine its effects on the Fox River, and to examine possible solutions to the problem. The methods of investigation involved standard water quality examination, and the influence of hydrocarbons, lead, dissolved oxygen and B.O.D. upon the algal, macroinvertebrate and fish communities.

The method of improvement involved diverting storm water effluent over a grassy field. The soil and plants of the "Green Belt" would be able to absorb, filter, and microbiologically decompose biodegradable materials found in the effluent.

River basin modeling has also been investigated as a method of generating data on point sources of pollution.

During the period of investigation, background samples were taken every Monday and storm water samples were collected during five rainstorms.

The work showed that, in the storm sewers under investigation, the storm water runnoff contributes many unwanted qualities to the nation's rivers and that these compounds do, in fact, alter the natural aquatic algal and macroinvertebrate communities.

Reference copy: Founders Memorial Library, Northern Illinois University

****

The Relationship of Oil Viscosity to Mosquito Larval Death

(Grant no. GY-11495)

California State College at Bakersfield
Bakersfield, California 93309

June 17, 1974 - September 6, 1974

Participants:

M. L. Barter*
D. L. Cox
D. T. Friesin
J. M. Gallon
C. L. Malsbary
C. L. Pigman
J. A. Self
H. O. Sio
J. O. Sio
J. D. Willey

*Student Project Director

F. T. Fang, Faculty Advisor

The main goal of this project was to find a relationship between oil viscosities and mosquito larvae death. The nature of the project was formulated from the fact that Kern County's industry is 80% agricultural and, as a result of the immense farming activities in the area, heavy irrigation is prevalent. This creates many pools of stagnant water, such as irrigation ponds and ditches, which are breeding places for mosquitoes. The ultimate goal, therefore, was to improve the elimination of these pests with oils which would have a lesser polluting effect than those presently used, such as phosphates, amines, etc. Testing was limited to the _Culex_ _tarsalis_ and the _Aedes nigromaculus_ mosquitoes which are among the several different species most abundant in this area.

A colony of _C_. _tarsalis_ mosquitoes was maintained throughout this project, and _A_. _nigromaculus_ larvae were obtained in limited numbers from the cotton fields south of Bakersfield, California.

Diesel oil used for cracking in the manufacture of gasoline and a light cycle oil were both fractionated to obtain differing viscosities of oil. Each boiling fraction was altered to contain 1% of a surfactant.

A difficulty arose as a result of analyzing the oil fractions by spectroscopy. The oils contained amines which are toxic to mosquito larvae. Also, research performed at the University of Texas Medical Branch at Galveston has shown that the hydrocarbon structure is important in the toxicity of oils to mosquito larvae.

Over 3,800 larvae were tested with volumes of oil equalling 0.98 gallons per acre-foot of water. The results of this inquiry only yielded information which was statistically valuable for the Culex mosquitoes. The limited number of Aedes mosquitoes did not provide enough information to overcome the variances encountered in analysis due to the previously noted toxic variables. The information from the Culex mosquitoes showed that there is a relationship between the viscosity of the important killing fractions and the syphon size of the larvae. Although the variables did not permit determination of specific viscosities for each syphon size, the change in important viscosities per change in syphon size were the same for diesel oil fractions, as for the light cycle oil fractions, and is 0.180 ± 0.045 centistokes per 0.01 millimeter change in the diameter of the end of the syphon.

Reference copy: Library, California State College at Bakersfield

****

A Limnological Study of Lake Perry with Emphasis on Net Primary Productivity (Grant no. GY-11453)

Benedictine College
Atchison, Kansas 66002

June 3, 1974 - August 9, 1974

Participants:

Craig Altenhofen	Diane M. Engelken*
Laurence Coker	Steven Hastings
Thomas A. Cuevas	Mary O'Connor
Mary E. DuBois	Mary E. Schulte

Arthur L. Shufflebarger

*Student Project Director

Fr. Eugene Dehner, Faculty Advisor

The main objective of this study was to determine the level of primary productivity of Perry Reservoir, including related physical, biological, and chemical parameters. A comparison of this data with a similar study performed during the summer of 1973 has yielded significant information beneficial to the maintenance of the quality of the reservoir as a conservational and recreational source, while also providing general information applicable to other reservoirs.

Water samples were collected 8 times throughout the summer at each of 8 selected sites. The tests were performed on these samples and results were correlated at the end of the summer with respect to their relationship to primary productivity, Perry Reservoir as a whole, and previous similar studies performed.

The following observations have been reached:

1. The amount of light transmitted to the lake was established as a major limiting factor in levels of primary productivity, along with a combination of other parameters.

2. Potential for primary production is greatest at the northern end of the lake, which is under the nutrient influence of the Delaware River. The net primary production rates were highest at these sites, but amounts were inhibited by turbidity.

3. Rainfall has a strong effect upon the lake as a whole. The run-off regulates the amounts of nutrients, such as nitrates and phosphates, which are drained into the lake, thus affecting primary production levels, bacterial populations, chlorophyll concentrations, phytoplankton and zooplankton.

4. Algal populations have reached a degree of stability as indicated by comparison with the 1973 report with this study. The Delaware River seems to serve as the greatest

source of recruitment for the existing algal populations.

5. Total bacterial populations were comparatively lower this summer, with fecal coliform/fecal streptococcus ratios indicating polluting sources to be of livestock rather than human origin.

Reference copy: Benedictine College Library

****

Fluoride Levels in an Ecosystem and Related Ecosystemic Changes (Grant no. GY-11450)

Evergreen State College
Olympia, Washington 98505

June 15, 1974 - September 5, 1974

Participants:

Melissa Brown
Mort Fabricant*
Sam Farmer
Geoff Gilbert
Kathy Roche
David Scoboria
Susan Southwick

*Student Project Advisor

Michael Beug, Faculty Advisor

There are four aluminum reduction factories located along the lower Columbia River. The production of aluminum requires 70 - 80 pounds of aluminum fluoride and 50 - 60 pounds of cryolite. Aluminum fluoride is 68% fluoride by weight and cryolite 61% fluoride by weight.

Acute injury to vegetation caused by emissions from aluminum factories is well documented. In a study in Idaho, Anderson (1966) observed that in a plant community exposed to high fluoride levels, some species decreased in frequency within the plant community, and some species increased in frequency.

We conducted a study of the density and diversity of species in the plant communities surrounding the Reynolds Aluminum factory at Troutdale, Oregon. An examination was made of the fluoride residue levels in plant leaves and in the visually evident burn of plant leaves. The second phase of our project was a baseline study of the plant communities surrounding the site of the proposed AMAX Aluminum factory at Warrenton, Oregon.

At Troutdale, we used a quadrant method for our plant community surveys. The methods for our field studies were modifications of Oosting (1956). Quadrant and transect methods were employed at Warrenton. The methods used for our laboratory analysis were modifications of Singer and Armstrong (1968); a Beckman fluoride selection electrode was used.

Our findings indicate that fluoride residues decrease with distance from the aluminum factory; levels remain higher in the direction of the prevailing winds. Baseline data from our Warrenton study indicated ambient levels at less than two parts per million.

The percent of visually evident leaf burn decreased with distance from the factory. We found a correlation coefficient of .79 between fluoride residue levels of Smilacina racemosa (False Solomon Seal) and the percent of visually evident leaf burn for Smilacina racemosa.

Trends indicating a reduction in diversity of species were seen in grassland habitats to the west of the factory. Our studies indicated no trends toward the reduction of diversity of species in forest habitats to the east of the factory. Only slight evidence was noted of reduction in the density of species. Several individual species were reduced in density.

In our plant community survey work, the small number of plots which were surveyed limits the conclusions we can draw from our data.

The trends that we have observed are significant, however. Reduced diversity lessens the stability of a plant community, making it potentially more vulnerable to infestation and disease.

If the AMAX factory begins operation, there will be five aluminum factories within a 200-mile stretch of the Lower Columbia River. Evidence from our Troutdale data indicates that significant levels of fluoride and resultant environmental damage will be present for most of the 200-mile distance from the Dalles to the mouth of the Columbia River.

Reference copy: Evergreen State College Library.

****

The Effects of Agricultural Run-off and Siltation on a New Recreational Lake (Grant no. GY-11527)

Illinois State University
Normal, Illinois 61761

May 28, 1974 - August 2, 1974

Participants:

Jerry M. Fioramonti
Debra J. Gillard
Glen L. Hortin
Linda S. Johnston
Thomas A. Nelson
Steven W. O'Neal
Steven J. Rakow
Allen C. Seivert*

*Student Project Director

Jo Marie Simkins

Michael E. Kurz, Faculty Advisor

Evergreen Lake, Bloomington, Illinois, was created by the impoundment of Six Mile Creek in August of 1970 to serve as a supplemental public water supply and a site of recreational development for the Bloomington-Normal area. Its geography is characterized by a shallow southern end fed by Six Mile Creek, the main feeder stream, and a deeper northern end near the dam. Plans for the Evergreen Lake area include construction of camping sites, a nature center, a swimming area, and a boat rental facility.

The fact that the 40-square mile watershed of Evergreen Lake lies in a predominantly agricultural area suggests that local farming practices may have a great effect on the ecology and water quality of the lake. The purpose of this study was to determine what effects the agricultural environment has had and will have on this lake. Toward this end, chemical investigations were undertaken to determine the nutrient levels in the water and lake sediment, as well as pesticide concentrations in the water and biomass. Populations of plankton, benthos, and fish were studied and a comparison was made between the north and south ends of the lake. The rate of sedimentation was also examined.

It was found that a nutrient gradient exists between the north and south ends of the lake. The average surface nitrate levels descended evenly from 11.5 ppm at the mouth of Six Mile Creek (south end) to 7.4 ppm in the deep section of the lake, while the total phosphate concentration decreased from

0.15 ppm to 0.05 ppm. The change in concentration of these nutrients over the length of the lake reflects the input from agricultural run-off. The only significant trend in the nutrient content of the lake sediment was a striking change in the levels of extractable phosphorus (decreasing in concentration with increasing water depth) which was attributed to the preferential adsorption of calcium phosphates onto the coarser sediment fractions. Except for high nitrate levels at the mouth of Six Mile Creek, the water in Evergreen Lake appears to be of good quality. Ammonia, chloride, total dissolved solids, and pH were well within the permissible limits set by the Federal Water Pollution Control Administration. Temperature and DO readings indicated that thermal stratification was occurring in the deep portion of the lake but not in the shallow end. This is because of the greater influence of wind and air temperature changes at the shallower depths (less than 30 feet).

Generally, chlorinated hydrocarbon pesticides were present in very low concentrations in the lake water, with only Aldrin being present in significant quantities (0.34 ppb). This can be attributed to the fact that Aldrin is still in limited use in central Illinois, while the application of other chlorinated hydrocarbons has been virtually abandoned. On the average, the south end of the lake contained higher levels of pesticides in the water, sediment, plankton, and fish; quite high levels of Dieldrin were found in the plankton (2870 ppb).

The phytoplankton population indicates that Evergreen Lake is maturing rapidly. Numerous genera of phytoplankton are present which indicate eutrophic conditions, but no phytoplankton typical of an oligotrophic state were found. In addition, Evergreen Lake supports 11 genera of zooplankton typical of mature bodies of water. Although the total population of plankton does not vary greatly over the length of the lake, it was found that the cladocerans and the phyla, Euglenophyta and Chlorophyta, were most abundant in the shallow end, while the phyla, Rotifera and Cyanophyta, were most abundant at the deep end.

In contrast to the plankton, the sparse populations of benthic organisms were felt to be indicative of the infancy of Evergreen Lake. The groups, Tendipedidae and Oligochaeta, made up 98% and 79% respectively, of the benthos in the north and south ends of the lake. The populations of Tendipedidae and Oligochaeta were found to be 323 and 384, and 60 and 152 mean organisms per square meter, respectively, for the north and south ends of the lake. The shallow end was found to have almost twice as many benthic organisms per square meter as the deep end.

Of the 1417 fish sampled from the lake, 75% of them were European carp or gizzard shad. A comparison of growth curves for Evergreen Lake carp and the average Illinois carp indicated that the Evergreen population was stunted. This was most likely due to overpopulation and the lack of benthic organisms. Gizzard shad on the other hand exhibited normal growth when compared to the average growth curve for the shad of another lake with optimum conditions. Other species of fish present in lesser number were bluegill (which closely followed the average Illinois growth rate), green sunfish, black bullhead, and white and black crappie. Although largemouth bass were found to comprise only 1.3% of the population sampled, their growth rate was greater than the average for Illinois.

The rate of sedimentation in the south end of the lake was found to be 3.6% capacity loss per year; in other words, the south end has a predicted lifetime of about 28 years. By assuming that the entire lake had the same average silt depth as the sections measured, one can roughly approximate a maximum capacity loss of 1.2% annually, significantly higher than the projected rate of 0.22%.

Indeed, it is felt that sedimentation will be the major factor influencing the water quality and ecology of Evergreen Lake in the future. The results indicate that in about 28 years the southern half of the lake will be heavily silted and the central portion will begin to resemble the present shallow end. Unfortunately, this section of the lake is near the area of intensive recreational development. The encroachment of sediment will not have a very great effect on the swimming facility, since it will be set off from the lake, but it will cause a substantial loss in lake area available for boating. The southern end of the lake is not only ideal for canoeing but of great ecological interest. The formation of mud flats from sedimentation will inhibit the establishment of aquatic vegetation which is needed as food for waterfowl, and thus decrease the value of the area as a site for environmental education. Hence, there is little doubt that the current rate of sedimentation will severely mar the beauty and utility of the southern part of the lake within 30 years. Siltation is not expected to become a factor in the northern half of the lake for many years.

Sedimentation will have the effect of "moving" the shallow portion of the lake northward; likewise, it is expected that the chemical and biological parameters which characterize the southern end will also be shifted. If crop rotation, fertilization practices, and rainfall patterns remain the same, there is little reason to expect a major change in the nutrient levels of the lake water. However, it is felt that increases in the nitrogen and phosphorus concentrations in the lake sediment are likely to occur. Barring an unusual increase in the use of chlorinated hydrocarbons as pesticides and herbicides, the concentration of those materials in the lake water, sediment, and food chain should remain well within accepted levels.

Since there appeared to be a correlation between total phosphorus concentration and the phytoplankton density, it is hoped that the nutrient levels in the lake will be such that any increase in the phytoplankton population will not be imbalanced in favor of the nuisance algae. The benthic populations are expected to increase as the lake ages, although the shallow areas will still support the largest and most diverse populations. An increase in the number of benthos could have a favorable effect on the growth of the European carp population; if other factors remain constant, this would only serve to accentuate the striking imbalance which presently characterizes the fish population. If Evergreen Lake maintains this imbalance, there is little hope that it will develop into a good fishing area. Although there are bass in the lake, the population distribution is skewed in favor of the larger fish. Apparently their rate of reproduction is insufficient to maintain a population necessary for reasonable fishing success.

Clearly, the agricultural environment of Evergreen Lake has influenced its early development and will in all likelihood continue to do so. Although the southern portion of the lake is experiencing problems typical of many man-made reservoirs, the northern half of the lake appears to be in good condition and holds definite promise for the future.

Reference copy: Milner Library, Illinois State University

****

An Analysis of Physico-chemical, Microbiological, and Macrobenthic Parameters of Geronimo Creek, Texas (Grant no. GY-11494)

Texas Lutheran College
Seguin, Texas 78155

May 27, 1974 - August 2, 1974

Participants:

Lee W. Cover	Sherril E. Janke
David W. Daum	Layne Johnson
Paul W. Daum	Laurence Whittle
William N. Freidrich*	

*Student Project Director

Richard L. Torgeson, Faculty Advisor

Geronimo Creek is a major tributary of the Guadalupe River, located in south central Texas. Presently, it is in a virtually unspoiled state as it travels its approximate

12-mile course from a series of underground springs in the Leona formation, which serves as its source, to the Guadalupe River. The small town of Geronimo is located along the upper portion of the Creek, two residential suburbs of Seguin, Texas are located nearer the mouth, with a number of farms in between. Developments are planned for areas along the creek, with septic tanks representing the primary method of domestic waste disposal.

This project was undertaken to examine three broad categories of water quality indicators; enteric bacteria; macrobenthic invertebrate populations, and chemical nutrients. It was anticipated that data would: 1) demonstrate the extent that present activity is having on the creek; 2) provide baseline information so that the effects of future developments and activity might be more precisely monitored; 3) supplement existing knowledge about the Guadalupe River with information from one of its major tributaries.

Eight sampling stations were chosen for their representative nature and accessibility, and 6 sampling dates were chosen for the microbiological and chemical tests at weekly intervals between June 13 and July 22, 1974.

The physico-chemical parameters of Geronimo Creek show it to be a very hard water stream (292 - 357 mg/l total hardness), with high levels of bicarbonate near the source. These appear to precipitate out as calcium carbonate, forming encrustations of marl on the rocks, from below station 1 to below station 3. Specific conductance values were rather high (788 - 1045 umhos/cm) in comparison to other surface waters in the area and are attributed to the hardness, significant bicarbonate levels, and the high nitrate nitrogen levels observed. Mean dissolved oxygen levels at all stations was greater than 7.3 mg/l during the entire study.

Except for nitrate nitrogen, other forms of nitrogen (nitrite and total Kjeldahl nitrogen) were found to be low. Waters in this area are generally considered to be high in nitrate nitrogen. The spring at the headwaters of Geronimo Creek was found to contain 6mg/l nitrate nitrogen. Areas along the creek subjected to intensive cultivation gave much higher values for nitrates, which we attributed to agricultural runoff.

Phosphates were found to increase after periods of heavy runoff. Particularly significant was the increase in total phosphate in areas of urbanization during these times. The remainder of the time phosphorus levels (total phosphate, inorganic phosphate, and organic phosphate) were relatively low and several times were below the minimum level of detection.

Three tests for enteric bacteria were performed, using the membrane filter technique: total coliform, fecal coliform, and fecal streptococcus. The highest value of total coliform was found directly below the town of Geronimo, but the values were significantly different (.05 percent level) from only two of the remaining 7 stations. Values ranged from a high of 6800/100 mls to a low of 1300/100 mls. The fecal coliform values were depressed along the entire length of the creek. Both total and fecal coliform results compared favorably with independent tests carried out by the Texas Water Quality Board on an area of the Guadalupe River upstream from the mouth of Geronimo Creek.

The fecal streptococcus values were also somewhat lowered. Values ranged from 1445/ to 800/100 mls. These depressed values were considered to be the result of a dry summer curtailing runoff.. The first collection, taken shortly after a heavy rain, provided the highest counts obtained during the study. Fecal coliform: fecal streptococcus ratios indicate that these two organism groups originate largely from animal wastes entering the creek.

Biochemical oxygen demand values during the entire period gave levels of oxygen depletion too low to be used as a reliable indicator. We attributed these low levels to a lack of sufficient organic material in the stream.

Two collections of benthic macroinvertebrates were obtained for the purpose of establishing species diversity indices for Geronimo Creek. Samples were collected by means of limestone rock-filled barbeque-baskets suspended 4-6 inches off the substrate for a period of 5 weeks.

A total of 36 groups were collected with diversity ($\bar{J}$) values ranging from 1.35 - 1.99. A very large proportion of each sample comprised two of four genera: Smicridea or Cheumatopsyche, of the order Trichoptera of Isonychia or Trycorythodes of the order Ephemeroptera. The inequitable distribution, as evidenced by the low evenness (e) values, appears to be the reason for the low $\bar{d}$ values. The large populations of the few genera present during the short time span when collections were made may represent a seasonal phenomenon. Until additional data can be collected over a greater part of the year, the significance of the low $\bar{d}$ values cannot be properly assessed.

Reference copy: Blumberg Memorial Library, Texas Lutheran College

****

Deer Creek: A Resource in Jeopardy (Grant no. GY-11438)

Goucher College
Towson, Maryland 21204

June 1, 1974 - August 31, 1974

Participants:

Joan Blakewick
Penelope Carroll
Lois Conn
Norma Lynn Fox
Mary K. Galt

Pam Grall
Anna S. Hand*
Susan Hebel
Margaret Nahm
Jane Suthers

*Student Project Director

John W. Foerster, Faculty Advisor

Deer Creek is a fast-flowing stream approximately 60 miles long, ranging in width from 10 to 100 feet. It is located in northeastern Maryland and southern Pennsylvania, lying in the Susquehanna River basin.

Deer Creek is a major spawning area for the anadromous fish populations from the Chesapeake Bay. These fish, belonging to the genus Alosa (herring, shad, etc.) use the lower few miles of the stream as a spawning ground. Prior to 1926 and to the construction of the Conowingo Hydroelectric Dam, the whole of the Susquehanna River Basin in Maryland and into Southern Pennsylvania was open to anadromous spawning. Now, only the lower 10 miles of the River and only two streams of any importance are available. Deer Creek is one of them.

Not only is Deer Creek of importance to the populations of herring for spawning, but it is also one of the few trout streams present on the Maryland coastal plain. According to unpublished data, there are 66,000 man days of fishing on the Susquehanna River and its tributaries below the Conowingo Dam; one-quarter to one-third of them are on Deer Creek. To analyze this water system and to predict the potential of this economically important fishery in light of ever increasing suburbanization is of great biological and economic importance. Besides fishing, other recreational interests use this stream and its bank for camping, boating and related activities.

Deer Creek flows through an agricultural area and acts as a collection and dispersal basin for both human and agricultural wastes. These nutrient encroachments are potentially dangerous to the organisms of the ecosystem. Thanks to a concerned group of resident citizens the Harford County Department of Health has been requested to make monthly fecal coliform counts and is doing so. These counts have been found to be well above the State of Maryland standards for recreational water content. The studies, however, have not determined the sources of pollution nor established a plan for dealing with further increases in nutrient input.

Several parks are along the banks of Deer Creek but no data are available to regional planners for recreation developmental purposes. Such information is essential as public concern has changed and is now directed towards resource conservation.

The conclusions derived from the study are:

1. The volume of Deer Creek during the summer and fall is inadequate to dilute waste liquor from the secondary plant in Pennsylvania.
2. Presently, the fecal coliform are above the State of Maryland standard for primary contact recreational waters.
3. The biochemical oxygen demand is high, indicating a heavy organic load.
4. Nitrogen and phosphorus analyses are considerably above levels for "clean" waters.
5. There is a low species diversity in the benthic animal community.
6. Escherichia shigella, an endemic human pathogenic bacterium is prevalent in most areas of the Creek.
7. Sediment load is high.
8. Dairy farmers use the stream as a place for dumping cattle wastes.
9. Recreational use is high.

Recommendations include:

1. The treatment plant at Stewartstown, Pennsylvania, must use an alternate stream in Pennsylvania for waste dilution or spray a percentage of waste on the ground during low water periods.
2. Consideration to keeping cattle out of the stream must be made.

3. The stream must not be damned for a water supply, as it will detrimentally affect flows and, thus, spawning activities of anadromous fish.
4. The package sewerage treatment plant at Jarrettsville, Maryland, must be improved.
5. Plantings of eroding hillsides must be made to retard erosion.
6. Trout stocking should continue.
7. Shad stocking should be instituted over a five-year period to insure the continuance of this economically important food fish.
8. Enforcement of the scenic resource designation must be improved.

Reference copy: Goucher College Library

* * *

Lobster Aquaculture, Ecology, and Tertiary Sewage Treatment in Controlled Environmental Systems (Grant no. GY-11544)

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

June 10, 1974 - August 30, 1974

Participants:

Joseph S. Levine
Frederick M. Mencher
David J. O'Neill

Barbara Plasman
Greg A. Redmann*
Jeffrey L. Star

Jeffrey L. Thielker

*Student Project Director

Non-Stipend Participant:

Karen Irving

John H. Ryther, Faculty Advisor

Research on the different aspects of the incorporation of Homarus americanus culture into the multi-trophic level marine aquaculture-wastewater treatment system of the Environmental Systems laboratory at Woods Hole was undertaken. Experiments were directed toward optimizing food sources available within the system, developing designs to facilitate high density lobster growth, and elucidating the ecology of Homarus.

The aquaculture-wastewater treatment system uses secondary sewage effluent (or its equivalent) as a nutrient source for marine phytoplankton ponds which, in turn, are fed into raceways containing racks of bivalves. The bivalves produce soluble nutrients used to raise macroalgae, and solid material (biodeposits) used to raise various deposit feeders. Almost all the nitrogen and over 50% of the phosphorus is removed from the wastewater by the artificial food chain.

In the current phytoplankton-bivalve-macroalgae aquaculture system at the ESL, the primary potential trophic pathways leading to lobsters are bivalve biodeposits, meiofauna, detritovores, herbivores, and macroalgae.

Individually-held postlarval lobsters fed oyster biodeposits took twice as long to molt to 5th state as Artemia fed individuals. Survival was proportionate to the amount of biodeposit present. Approximately 7500 ug carbon and 1300 ug nitrogen was the maximum amount available per lobster; however, this varied due to fluctuations in the phytoplankton supply.

Meiofauna experiments showed that 93% of postlarval lobsters fed detrital milofauna molted to 5th stage, compared with 33% of those fed only biodeposits over a 3-week period. Niche competition experiments over the same period with Nereis and lobsters held together (using meiofauna as the food source) showed that Nereis had a greater survival than the postlarval lobsters, 75% vs. 54%, but the lobsters had a greater total weight increase, 60% vs. 30%. Postlarval lobsters did not eat 1½"-inch Nereis.

Postlarval lobsters held in screened one-pint plastic containers with oysters and Capitellid polychaetes at a density of 1,000/m^2 showed that 4th and 5th stage postlarval lobsters grown with Capitelle had a 40% greater growth increment per molt than the lobsters held only with oysters for a total increase of 71±14% in weight. Capitellids have previously been grown as detrivores in the aquaculture system to densities of 110,000/m^2. Experiments with lower levels of Capitella or with the macroalgae, Chondus crispus, showed no significant lobster weight increase, when compared with controls. Similar feeding experiments with 7th and 8th stage lobsters, using components of the epifaunal communities found in the raceway (primarily various amphipods and mussel spat, forming a Ceremium-Jassa-Mytilus association) showed significant weight increase (81± 20%) compared to the biodeposit fed controls.

Wood and Vexar bivalve-holding trays in use at the ESL were modified and made postlarval lobster-tight by covering with fine mesh. Trays holding postlarval lobsters at densities of $50/m^2$ and $17/m^2$ with live oysters and typical raceway fauna had similar survival, about 60%, and growth after a 40-day period. The mean increase in carapace length over 60 days was from 4.2mm to 13.6mm. Live oysters, or empty shells, with lobsters stocked at $34/m^2$ and Artemia added were found to be equally suitable as substrates with over 50% survival over a 25-day period. Artificial substrates also used in a similar experiment at $74/m^2$ showed that survival was greater in a 3 cm high vertical maze of corrugated fiberglass filon roofing material, than in 3M Conservation Webbing 200, 54% to 13% respectively.

Molt delay assays with pairs of postlarval lobsters, were used to determine what habitat conditions induce the least amount of agonistic interaction. Oyster shells, vertically-arrayed fiberglass maze, PVC shelters and lobsters held without claws were compared to a control group of individually held lobsters. Fiberglass maze, oyster shell, and lack of claws produced the least differences in time of molt for a pair of lobsters held together, less than 2 days as compared with 3.8 days for pairs of lobsters held with the PVC shelters. Greatest survival and total biomass was achieved by the clawless pairs.

Postlarval lobsters held in $25/m^2$ tank divisions, at $50/m^2$ under similar conditions and combinations as in the above experiments for 50 days, showed greater survival and biomass (although less weight per individual) in the clawless pairs held with maze, having 85% survival and $30g/m^2$, whereas clawed lobsters with and without maze had respectively 68% and 40%

survival, at $22g/m^2$ and $18g/m^2$.

Postlarval lobsters were added to a partitioned-off area of the raceway with a stock of unmodified bivalve trays, hopefully to distribute themselves vertically and settle among the trays. However, Fundulus in one test and grass shrimp in the other somehow entered from adjacent raceways and eliminated all but about 8% of the introduced lobsters. Some sort of tray modifications will probably be necessary to raise postlarval lobsters successfully in the raceways.

Distribution in a multiple-tiered environment was studied in subadult lobsters by using a covered, suspended cage and in postlarval lobsters by observations in a smaller scale aquarium arrangement. Provided with a variety of potential food items from the raceways, hemitubular shelter, and inter-tier ladders, the older lobsters tended to distribute themselves evenly on the several layers, although cannibalism at molting did not seem to be reduced. Roaming and aggressive behavior did not mature until 7th stage in the postlarval lobsters, and their tier settlement seemed to be transient and inversely related to light levels.

A mesh-size selection experiment using four equal-sized boxes with varying sized mesh corresponding in hole diameter to different carapace-size classes of lobsters showed that the degree of mesh box occupancy and mortality was inversely proportional to the size and, presumably, dominance of the lobsters. This arrangement for self-induced size selection can also serve as a harvesting method for different sizes of lobster from a communal rearing system, and to reduce agonistic interaction between different size classes. The optimum self-selected stocking density derived from this was about 45 lobsters/m^2 through the 12th stage.

Observations on postlarval behavior and interaction with potential food species were made with a light-regulated 20-gallon aquarium. Results show that postlarval lobsters feed readily on the various species potentially found in the raceway, except for the isopod, Idotea sp. and increase their dietary range 9th stage. There is little intraspecific interaction and a bimodel activity peak with a photoperiod and an oyster-shell substrate at a density of 50/m^2. There was extensive interaction and some mortality at 100/m^2. Both interaction and vertical distribution in a multiple-tiered system increase in the absence of light. Climbing activity increased with the addition of mesh ladders to the tiers.

Postlarval benthic settlement preferences were examined by releasing the lobsters into a round tank divided into sections containing local bottom types of Chondrus, Zostera Codium and oyster shells. Lobsters preferred Chondrus somewhat over the other species, but the difference was reduced when rocks were added with all the species. Chondrus with 5-40cm rocks were greatly preferred to rocks by Chondrus alone, and in all tests, the preference for oyster shells equalled that of the optimal natural substrate.

Food selection preferences were derived for subadult (45-65mm carapace length) lobsters from the determination of electivity indices for 13 possible food species. In order of preference and E' value, are Artemia, 1.88; Nereis, 1.69;

Fundulus, 1.43; *Palaemonetes*, 1.35; *Cancer*, 1.31; *Strongylocentratus*, 1.12; *Asterias*, .94; *Mytilus*, .85; *Arbacia*, .60 *Littorina*, .45; *Homarus*, .37; *Gracilaria*, .06, and *Chondrus*, .05.

It appears that *Homarus* can be a viable component of the aquaculture-wastewater treatment systems. Further work is needed and is being done, primarily as long-term studies with older lobsters and the development of specific food-related habitat designs.

Reference copy: Woods Hole Oceanographic Institution Document Library and Woods Hole Oceanographic Institute Biology Department

****

Physical, Chemical, and Biological Analysis of a Disposal Site for Hazardous Waste (Grant no. GY-11528)

University of Oklahoma
Norman, Oklahoma 73069

June 1, 1974 - August 3, 1974

Participants:

Susan V. Bermudez	Lawrence A. Kapustka*
Steven Flaniken	Thomas A. Morrison
Bobby Glover	R. Dean Wingo

*Student Project Director

Robert Y. Nelson, Faculty Advisor

A privately owned and operated hazardous waste disposal site located in Central Oklahoma was studied during the summer months of 1974. Chemical, physical and vegetational parameters of the site were measured in order to provide a basis for evaluating this particular operation and to provide recommendations for developing, managing, and regulating future disposal sites.

The waste materials delivered to this site can be grouped into four general categories: non-volatile organics; volatile organics; pesticides; and inorganics. At its inception, the disposal site consisted of several discrete lagoons designed to handle the various waste materials. By mid summer 1974, the contents of many of the lagoons were allowed to mix, resulting in a more homogeneous system. Throughout the summer, the aqueous fraction was pumped through a sprayer to enhance evaporation and, thus, to reduce the volume of the lagoons. This was necessary because, at times following rain, the volume approached overflow levels.

Chemical analyses which were performed include: phenol, nitrite nitrogen, ammonium nitrogen, COD, pH, chloride, phosphate, residue, qualitative cation analysis, and atomic adsorption spectrophotometry for selected cations of both the aqueous fraction and the sediment layer of the lagoons. Comparisons of the aqueous fraction and the sediment layer confirm the expected accumulation of the relatively insoluble metals in the sediment. Cations notably absent from the solution are Hg^+, As^+, and Ag^+.

The hydrocarbon content of the air was also determined. Ambient levels early in the year were around 20 ppm near the lagoons, but diminished rapidly with distance from the source. By mid summer, the source had been vaporized so that ambient levels were at or near normal background levels of 4 ppm.

Microorganisms were studied in an effort to describe the toxicity of the waste materials. A few organisms were found capable of substantial growth in concentration of 75% waste water. However, laboratory experiments in which waste water was added to water from the Washita River showed that the waste would have to be diluted more than 10^6 times before the general toxicity became negligible.

The vegetation was examined to aid in the assessment of the effects of the disposal operation on the neighboring environment. A narrow zone around the lagoons showed signs of damage, presumably due to exposure to volatile hydrocarbons. The extent of this damage was considered negligible. Aerial portions of plants were examined for content of selected metals. Extremely high concentrations found in the vegetation at considerable distances from the lagoons can be attributed to the spraying of waste waters into the air in an effort to enhance evaporation. Cr, Cu, and Cd were found at concentrations in excess of minimum dietary levels that are toxic to animals. These findings warrant the cessation of spraying as a means of increasing evaporation.

Alternative management procedures, such as incineration, neutralization and/or precipitation can be disregarded because of the great cost involved. The most economical management practice is a lagoon-land fill system that allows for maximum evaporation of liquids to reduce volume. We propose the following general design as a means of providing an economical and safe operation. The waste materials should be segregated in lagoons for organic volatiles, oils, and inorganics. Cyanide compounds, because of their special toxic nature, should be buried separately, preferably in sealed containers to preclude liberation of the deadly gas. The aqueous fraction of the lagoons would be cycled *via* pump stations over a black plastic tarp to enhance evaporation. As an added safety feature, the site should contain a retaining dike capable of handling any spillage from the lagoons that might occur from storms.

Reference copy: Bizzell Library, University of Oklahoma

****

Impact of Feedlots on Water Quality of the Upper Iowa River Watershed (Grant no. GY-11535)

Luther College
Decorah, Iowa 52101

May 27, 1974 - August 16, 1974

Participants:

James Burmeister
Tom Coon
Mary Edwards
Virgil Heitz
Je[illegible] Kuhns

Steve Murray
Donna Poesch
Judy Scherpelz*
Richard Steinberg
Leslie Zimmerman

*Student Project Director

James Eckblad, Faculty Advisor

To determine the effects of feedlot runoff on the water quality of the Upper Iowa River Watershed, seven feedlots were sampled upstream and downstream from their effluents. Samples were taken four times throughout the summer and during and after a rainfall. Parameters examined included water chemistry, coliform bacteria, macroinvertebrates, and fish. Also studied was the economic situation of the average farmer in Winneshiek

County, Iowa, with respect to the recommended feedlot pollution control regulations.

Chemical analyses included temperature, pH, specific conductivity, turbidity, nitrite-nitrogen, nitrate-nitrogen, ammonia nitrogen, organic nitrogen, orthophosphate, total phosphate, dissolved oxygen, chemical oxygen demand, biological oxygen demand, alkalinity, total and dissolved solids, and total organic carbon. Little consistency was seen in the measurements taken during dry weather. However, during rainfalls nitrates were shown to increase from 3.9 to 4.16 mg/l at site 4. Nirtite values ranged from .001 to 1.4 mg/l.

Coliform bacterial counts were inconsistent during dry weather, with counts downstream from sites 4,5, and 6 ranging from 450 to 1900 organisms/100 ml. Both sites 3 and 7 had greater counts upstream (17,000 and 12,000), possibly due to the greater chemical pollution at these sites. Values increased especially downstream from effluents, up to 27,000 organisms/100 ml during rain, due to the flusing out of feedlots. In the macroinvertebrate studies, Trichoptera and Ephemeroptera showed the higher frequencies downstream of the effluents. Diptera and Chironomids were generally less frequent downstream.

Analysis of fish populations showed a total of 22 species present; 14 species had more individuals downstream. The most common species were _Semotilus atromaculatus_, _Pimephales notatus_, _Notropis dorsalis_, and _Notropis cornutus_, comprising 58% of all fish caught. Of the 929 total fish, 608 were downstream from the effluents.

In general, the moderate form of pollution noted served to enrich the habitats for the aquatic life. However, the samples taken during rain demonstrated an increased pollution downstream from the effluents. While one small feedlot may not have a drastic effect on the water quality, an area with many small feedlots has the potential to endanger the aquatic habitats, especially during a rain.

It is not economically feasible for the average farmer in this area to change his feedlot to a modern, pollution-controlled arrangement, as is advised for large operations. Costs may range from $400 - $3,000 for construction and $150 - $600 per year for maintenance. Federal aid and cost-sharing programs are recommended. Care must be taken in the future planning of new feedlots and in the maintenance and monitoring of present feedlots, to refrain from upsetting the balance of the aquatic habitat.

Reference copy: Preus Library, Luther College

Biological, Geological, and Physical-Chemical Parameters of a Southeast Texas Estuary (Grant no. GY-11509)

Lamar University
Beaumont, Texas 77701

June 1, 1974 - August 9, 1974

Participants:

Daniel P. Bales
Beverly Burnett
Gregory Chambers
Brandt F. Henningsen*
James O. Jones
Jerry L. Parsley
Rocky R. Roden
Robert L. Savino

*Student Project Director

Ernest L. Estes, Faculty Advisor

Keith Lake is a shallow 2200-acre brackish water body surrounded by extensive salt marsh tidelands. The lake is located in the southeast corner of Jefferson County, Texas, near Sabine Lake and the Texas-Louisiana border. It is one of a series of small lakes which connect with an intra-coastal waterway that drains into the Gulf of Mexico. A study of various geological, physical-chemical, and biological parameters was made which included the documentation of existing conditions and possible explanations for gradual environmental changes that have occurred since the lake's closing from direct Gulf of Mexico tidewaters in 1962. Geological parameters included sedimentological and geochemical analyses of extracted core samples (an attempt to reconstruct the lake's history since 1962). Physical-chemical parameters were studied in samplings of various lake conditions over an eight week period. Biological parameters included the identification of macrofauna populations, correlation of net plankton population with estimated primary productivity, and a brief review of surrounding marsh flora and fauna.

From fifteen core samples, sand, silt, and clay percentages were determined by pipette and sieve analyses. Carbonates, organics, and heavy metal concentrations (Pb, Cu via atomic absorption spectrophotometry) were also determined.

Through sampling of twelve stations twice weekly, the following physical-chemical parameters were monitored over time: salinity, conductivity, temperature, dissolved oxygen, dissolved carbon dioxide, pH, alkalinity, turbidity, Secchi disk depth, phosphates, nitrates, currents, and primary productivity (five stations over two diurnals). In situ measurements were made with a Beckman induction salinometer, portable Hach water analysis kit, and a Tsurumi-Seiki impeller type current meter.

Macrofaunal populations were sampled by means of 20-foot otter trawl and a hand-drawn minnow sein. Four plankton stations were sampled weekly by filtration of ten liters of surface and bottom waters through a #25 mesh Wisconsin plankton net. Population estimates were made with single counts of a Sedgewick-Rafter or Palmer counting cells. Productivity estimates at each station were made through the use of the 24-hour light-dark bottle method; surface and bottom bottle sets were incorporated. Observations and collections of marsh flora and fauna were conducted throughout the study.

The estimated sedimentation rate of Keith Lake since 1962 was indicated to be 6.5 to 7.5 cm/year, predominant sediments being silts and clays. Higher sand percentages were found in the northeastern sectors of the lake, possibly due to a prevailing southeasterly wind and the resulting winnowing effect. Low carbonate and organic levels were found in surface sediments. A general trend of increased percentages with depth was observed. Heavy metal analyses of sediments showed Pb averages of about 4-6 ppm, with higher concentrations of 12-30 ppm being noted in association with levee fill material. Concentrations of Cu ranged from 3-14 ppm, with highest levels also being associated with levee fill material.

The average salinity of the lake was found to be about 4 ppt. Stability of the remaining physical-chemical parameters was also noted; conditions did not appear to be affected by diurnal tidal variations because of the semi-isolation of the lake from the Gulf. Turbidity and Secchi disk depth did exhibit large variations in relation to wind and wave induced re-suspension of bottom sediments. No currents were found except for wind driven surface movements.

Thirty-two euryhaline fish species were collected. Dominant populations of Micropogon undulatus, Mugil cephalus, and Anchoa mitchelli were noted. It is known that previous populations of popular game fish have been gradually repressed and replaced by less desirable game fish since 1962. Shrimp populations were characterized by juvenile forms of Penaeus setiferus, Penaeus aztectus, and Palaemonetes pugio. A valuable shrimp nursery ground has been isolated with the lake's closing, as evidenced by decreased shrimp catches in the associated area, small shrimp populations within Keith Lake, and greater shrimp populations with progression toward the more saline intracoastal waterway. Previous populations of Crassostrea virginica were eradicated, possibly due to low salinities and lack of substrate. Rangia cuneata could be found in high densities.

Net plankton populations of the lake were low, ranging from 92 to 3242 per liter. Forty-seven species of plankton were identified. Species diversity figures for plankton were also low. Low net primary production figures ranged from

-684.65 to 472.95 mg C/m^2/day. The system illustrated a border-line autotrophic state; production deficits may be supplemented by marsh production. Small plankton populations and low production may be the result of low salinity waters, irregular high turbidity, low nutrients, and poor lake circulation.

Marshes were characterized by _Spartina_, _Scirpus_, _Cyperus Borrichia_, and numerous other typical marsh plants. Many organisms were noted within the marsh. Tidal action appeared to have little effect on the marshlands.

Reference copy: Lamar University Library

****

Mathematical Modeling Applied to Lehigh River Water Quality

(Grant no. GY-11518)

Lehigh University
Bethlehem, Pennsylvania 18015

June 10, 1974 - August 30, 1974

Participants:

Charles W. Coe	Joseph M. Hoch
Michael P. Evans*	JoAnn Kerrick
Theodore H. Fedynyshyn	Jeffrey Miner

Thomas Stauffer

*Student Project Director

Non-Stipend Participant:

Joel Caves

Robert L. Johnson, Faculty Advisor

LERMP (Lehigh River Modeling Project) involved field, laboratory, and quantitative analysis of various water quality parameters for the critical lower 47-mile stretch of the Lehigh

River and the application of a steady state mathematical model utilizing the accumulated data.

During the eight weeks of intensive river sampling, five runs of the Lehigh River were completed which included 41 river stations, 22 tributaries, and 55 effluents. All grab samples were taken in appropriate containers, chilled, and analyzed the same day or the following in the Lehigh University sanitary engineering laboratory. The following water quality parameters were measured: temperature, dissolved oxygen, (DO) 5-day biochemical oxygen demand (BOD_5), pH, alkalinity, hardness, total and fecal coliforms, fecal streptococci, chloride, sulfate, nitrite, nitrate, ammonia, Kjeldahl nitrogen, phosphates, calcium, magnesium, potassium, and sodium.

The flow for each effluent and tributary along the reach from Jim Thorpe to Easton, Pennsylvania had to be measured, estimated, or calculated. The Ott current meter was used to measure the Lehigh River flow at five stations. The river had an average summer flow of 400 cfs at Jim Thorpe and 1045 cfs at its confluence with the Delaware River.

Several special studies had been previously done on the Lehigh River which drains 1364 square miles. However, the limited amount of water quality data generated was only useful as background information and was not adequate for the summer modeling approach. Besides being input for the desired model, the extensive water quality and quantity analyses serve as a data base for critical summer conditions on the lower Lehigh River.

Because of its completeness, flexibility, computer adaptability, and documentation, the new steady state AUTOSS model from the Environmental Protection Agency, part of the AUTO-QUAL modeling system, was chosen for application to the river. The flow and chemical constituents for each effluent and tributary were input into the mathematical model which had been set up on the Lehigh University CDC 6400 computer. Using the "channel-junction method" to represent the river, the AUTOSS model predicts conservative chemical parameters for equal-sized river sections by mass balance techniques. The 47-mile length considered was divided into 100 sections, each of about 0.5 mile. The model used decay and other interaction variables to model the nonconservative constituents of dissolved oxygen, biochemical oxygen demand, nitrogen forms and bacteria, all of which react through time with the water.

The model mass balance for chemical constituents generally predicts a concentration profile similar to actual measurements. Most increases in flow and chemical constituents occurred between Allentown (RM 16.0) and Glendon (RM 3.0), caused by Allentown sewage, Little Lehigh Creek, Monocacy Creek, Bethlehem Steel Corporation, and Saucon Creek (which contains Bethlehem sewage flow).

Dissolved oxygen was the major constituent of concern. Various sources and sinks could be accounted for by the AUTOSS model. Assuming negligible photosynthetic activity and benthal demand, a profile agreeing within 1 mg/ℓ DO was developed. The river has near saturation DO of 9 mg/ℓ from Jim Thorpe to

Allentown. Below Allentown, an oxygen demand is exerted which causes a sag to 4.5 mg/ℓ before the Glendon Dam (RM 4.0), followed by recovery to about 8 mg/ℓ before the Easton Dam (RM 0.3). Much of the oxygen decrease was accounted for by nitrification of the heavy ammonia loadings from Bethlehem Steel Corporation and Saucon Creek. General literature values were used for the ammonia decay rates. Reaeration rates computed by the Dobbins O'Connor formula were adjusted upward because of the aeration of the numerous low-head dams. Further studies would be needed to verify the assumed parameters which produced a sag profile within 0.5 mg/ℓ DO.

The predicted bacterial concentration showed the greatest variability from measured values. High total coliform levels of from 1000 to 6000 organisms per 100 mℓ exist over the 47-mile stretch. Bacterial concentrations from wastewater treatment plants on the river and tributaries maintain the high concentrations in the Lehigh River.

Water quality data are one of the major limitations to applying a proper mathematical model to a river. This study focuses the need for futher work in the lower Lehigh River below Allentown to assess better the exact interactions which cause the DO sag. Also, the sources of bacterial contamination must be isolated and treated to permit safe water recreation on the Lehigh River.

Reference copy: Mart Engineering and Science Library or Fritz Engineering Laboratory Library, Lehigh University

****

Application of Modeling and Simulation Techniques to Air Pollution Control Problems (Grant no. GY-11474)

Manhattan College
Bronx, New York 10463

June 10, 1974 - September 2, 1974

Participants:

Anthony Corvini	Lidia Llamas*
John DiBiase	Anthony Mercando
Barbara Greenberg	Joseph Quinlan
Steven Kadden	Joseph Valdes

*Student Project Director

Joseph Reynolds, Faculty Advisor

This project is concerned with the application of modeling and simulation techniques to the solution of pollution control problems. Five different problems were investigated. Computer simulations were performed for the operation of a Venturi scrubber, bag filter, and for the prediction of plume dispersion during temperature inversions. Well known numerical techniques have been employed. In addition, the results of the development and construction of a bench scale electrostatic precipitator for verifying an existing model that predicts collection efficiency were determined. Finally, a study was made of the theoretical considerations involved in removing pollutants from a gas stream by condensation.

The Venturi scrubber model simulates the operation of a scrubber, given variables such as gas and liquid flow rates, particle loading, and scrubber dimensions. The model only considers a monodispersed aerosol and an average size particle.

Five different equations describing changes in gas velocity, liquid velocity, void volume, pressure drop, and particle concentration as a function of distance down the throat were solved simultaneously using a Runge-Kutta forward integration technique. Runs were made using liquid to gas ratios from .5 to 5 for different throat diameters and particle sizes. Reasonable collection efficiencies have been obtained. The remaining work involves the expansion of the program to include particle size distribution, and droplet size distribution. Also, collection efficiency data must be gathered to verify the model.

A similar approach was used in the study of fabric filter operation. The computerized model developed simulates the operation of a constant rate, variable parallel resistance, pulsed air bag house, containing four rows of bags. Five differential equations were solved by the Runge-Kutta method. Start-up effects leading to the achievement of steady state have been taken into account. The main objective of the program was to predict the pressure drop across the baghouse, as well as the volumetric flow rate and volumetric throughput across each row of filter bags, as a function of time.

The next problem to be studied using this approach was the atmospheric dilution of plumes during temperature inversions. An unsteady state model was employed which uses a point source as a representation of the stack. Briggs model for plume rise is used in conjunction with diffusion equations predicting horizontal dispersion of the plume. A numerical method was employed to solve the describing equations with the aid of a computer. The program uses a three-dimensional grid with the first two indices representing the x and y coordinates and the third, time.

The fourth study deals with the design and construction of a bench scale electrostatic precipitator used to test the validity of a computerized model developed at Manhattan College which predicts collection efficiency. The model uses the Monte Carlo method to simulate particle collection in the precipitator. Because of a lack of appropriate data from industry to verify the model's predictions, the laboratory scale precipitator was developed. Isokinetic samplers were placed at the inlet and outlet of the tubular precipitator which collect particles from an aerosol generator on to Millipore paper. Two methods were used in measuring the number of particles captured. The first was an actual count of particles under a microscope. The second involves the use of methylene blue particles. The collected particles were washed out of the paper with a given amount of water. The concentration of the particles was then measured colorimetrically. Both techniques have advantages and disadvantages. Many problems still remain in perfecting this methodology so that a true evaluation of the computerized model can be achieved.

The final problem studied was the application of surface condensers as a means of controlling discharge of condensable vapor pollutants to the atmosphere. With emphasis on increased performance of air pollution control equipment, it is desirable to develop a sound, rational approach to the design of condensers. A generalized method was developed, based on available theory to predict collection and design surface condensers. The only information that is required in this method is the phase equilibrium constant or vapor pressure, and enthalpy data for the constituents in the system.

Reference copy: Manhattan College Library

****

The Effects of Acid Rainfall on Nitrogen Fixation in Western Washington Coniferous Forests (Grant no. GY-11470)

Evergreen State College
Olympia, Washington 98505

June 10, 1974 - August 30, 1974

Participants:

Steve Anderson
Bernard Bormann
Bruce Caldwell
Bob Denison*
Lindell Eldred
Cindy Swanberg

*Student Project Director

Oscar Soule, Faculty Advisor

Normal rain is slightly acidic because of the carbon dioxide in the atmosphere; it is buffered by bicarbonate to a pH of about 5.7. In polluted areas, sulfur dioxide or oxides of nitrogen dissolve in rainwater to form dilute sulfuric or nitric acid. Rain pH values as low as 2.1 (more than a thousand times as acidic as normal rain) have been recorded in the United States.

Possible effects of acid rain include fish kills (through acidification of rivers and lakes), corrosion of metal and stone, increased leaching of soil nutrients, and direct effects on higher plants. Since many nitrogen-fixing organisms are known to be sensitive to acid, we studied the possible effects of acid rain on nitrogen fixation.

Only a few bacteria and blue-green algae have the capacity to fix atmospheric nitrogen. Other organisms, such as legumes, alder trees, and some lichens, form symbiotic partnerships with N-fixing microorganisms. Since nitrogen is the principal limiting nutrient in western Washington coniferous forests, and microbial nitrogen fixation is the major input of nitrogen into this ecosystem, a decrease in N-fixation could have serious consequences.

We found that rain in the Olympia area is more acid than one would expect in a relatively unpolluted area. Rain collected in November and December of 1974 had a weighted mean pH of 4.97, more than five times as acid as normal rain. However, there are a number of natural mechanisms to prevent acidification. pH buffering by the tree canopy has been reported, and would prevent acidification of through-fall unless and until the buffering capacity of the canopy is exhausted. If that were to happen, the direct effects on trees through foliar damage would probably make any effects on N-fixation insignificant by comparison. We also found pH buffering in soil and litter. Buffering capacity was measured by adding acid to soil and litter samples, both through simple titration in solution, and by spraying samples with simulated acid rain, and monitoring the decrease in pH using the glass electrode method.

Nitrogen fixers in these forests include red alder trees, soil and litter microorganisms, microorganisms inhabiting the surface of conifer needles, and the lichen, Lobaria oregana, which dominates the canopy of the old-growth forest. Red alder was not studied.

We measured rates of N-fixation, using the acetylene reduction method. Soil and litter had low rates of fixation, and probably contribute less than 5 kg N/ha/yr to the forest. Rates of fixation were higher in litter than in soil. We applied water and acid to the forest floor, and found that there was less fixation at low pH. However, lack of moisture is a more serious limiting factor in summer. Application of pH 3 water actually stimulated N-fixation, although pH 6 water stimulated it even more. Extensive attempts to culture the microorganisms responsible for N-fixation in soil and litter were unsuccessful. Some bacteria grew in "nitrogen-free" media, but N-fixation by these cultures was lacking or below the level of detection.

The surfaces of Douglas fir needles support a community of algae, fungi, bacteria, and micro-lichens. This community, is often present in quantities large enough to be visible without magnification. The community fixes nitrogen at a rate higher than that of soil and litter, but little is known about its abundance. Community bacteria fixed nitrogen in culture, but were not positively identified. They were similar in several ways to Azotobacter species, which are very active N-fixers. These, however, are so sensitive to acid that only in protected micro-environments, among masses of community algae would they be able to survive. The natural acidity of fir needles would be enough to block N-fixation by members of this genus, even without acid rain.

The highest rate of N-fixation was that of the epiphytic lichen, *Lobaria oregana*, which contains a N-fixing blue-green alga. This species may contribute as much as 75 kg N/ha/yr in the old-growth forests where it is abundant. We showed that it is sensitive to acid and it is known to be extremely sensitive to sulfur dioxide. We also found that the rate at which it fixes nitrogen is greatly affected by light, temperature, and moisture. It is not found in appreciable quantities in most commercial forests, because trees are harvested at an age less than that at which this lichen becomes abundant in the tops of trees.

N-fixing bacteria in root nodules of red alder, *Alnus rubra* reportedly fix on the order of 100 kg N/ha/yr. This tree is often deliberately suppressed by foresters because it competes with Douglas fir. Man may decrease nitrogen fixation in forests through acid rain, but that effect is minor compared to wholesale destruction of nitrogen fixers by harvesting the old-growth forest, and spraying of alder.

Reference copy: Daniel J. Evans Library, Evergreen State College

****

Slag/Slag-Thermal Effects on Hatchability of Pimephales promelas, Brachydanio rerio, Asellus intermedius (Grant no. GY-11423)

Loyola University of Chicago
Chicago, Illinois 60626

June 1, 1974 - August 24, 1974

Participants:

Jeffrey B. Augustine
Howard J. Beck
Gregory W. Kamykowski
Anthony A. Kozlowski*
Mark M. Kozubowski
Wanda M. Kwaczeniuk
Anthony M. Martino
James T. Mayes

*Student Project Director

Robert W. Hamilton, Faculty Advisor

The fathead minnow, *Pimephales promelas*; zebra fish, *Brachydanio rerio*; and isopod, *Asellus intermedius*, were studied from a developmental approach to determine the effects of unprocessed air-cooled blast furnace slag on the developing embryo. In the laboratory, the eggs of the three species were subjected to various slag-water mixtures at two temperatures, 25°C and 30°C. This was done in order to assay marked short-term responses of hatchability and physical development of the embryological biota to toxins already present at contact with slag or elicited into the water after a controlled period of time. Chemical analyses were performed for sulfide, sulfate, manganese, chromium, aluminum, chloride, dissolved iron, nitrate-nitrite, chemical oxygen demand, suspended residue, total hardness, and pH.

All three species tested exhibited similar trends in susceptibility to blast furnace slag. Hatching success was greatest for zebra fish eggs at 25°C. Least tolerant were fathead minnow eggs at 25°C. Isopod eggs formed an intermediate group, before fathead minnow eggs at 30°C. Mortality increased with greater concentrations of slag. At the highest slag concentration (20%), the mean hatch was less than 1% for all organisms (except zebra fish at 30°C, in which the mean was 2.8%). At the lowest slag concentration (0.1%), the mean hatch was still significantly lower than controls. At 25°C in 0.1% concentrations, the mean hatch for fathead minnows was 52.7%, for zebra fish 63.6%, for isopods 68.6%. At 25°C in controls, the mean hatch for fathead minnows was 69.5%, for zebra fish 84.4%, for isopods 92.1%. At 30°C in a 0.1% slag concentration, the mean hatch for fathead minnows was 50.9%, for zebra fish 85.9%. At 30°C in controls, the mean hatch for fathead minnows was 86.1%, for zebra fish 92.6%.

Chemical analysis data demonstrated abnormal levels (compared with those in Lake Michigan) of sulfide, sulfate, hardness, pH, and chemical oxygen demand.

Abnormalities in development included chorionic splitting, distorted tails, improper body proportions, incomplete development, pericardial edema, thrombosis, inhibited yolk utilization, lethargy, fragmentation of eggs, blackening of the isopod marsupium, and regression of oostergites in gravid female isopods.

Reference copy: Elizabeth M. Cudahy Memorial Library, Loyola University

****

A Comparative Study of Three Central West Virginia Streams, Investigating the Effects of Acid Mine Drainage on Fresh Water Organisms (Grant no. GY-11529)

West Virginia Wesleyan College
Buckhannon, West Virginia 26201

June 10, 1974 - August 30, 1974

Participants:

Louise Helen Atkiss	David William Burr
James Paul Bauer	Gary Ray Colerider
Brent Ross Berisford	J. Bradley Metzger*
Mary S. Boyd	Theresa Ann Steeper

James Paul Tindilia

*Student Project Director

Carl M. Colson, Faculty Advisor

The primary objective of this study was to investigate the effects of various components of acid-mine drainage on local aquatic organisms. Three streams in close proximity and representing water qualities, ranging from severely polluted by mine drainage to virtually no detectable influence, were chosen for the study.

Two major approaches were used in undertaking the study. The first was a comparative study of the streams which included water analysis, species diversity, and population density determinations. Water samples, tested for total acidity (hot and cold), calcium and magnesium hardness, pH, total iron and dissolved sulfate, were collected at 25 sites, taken every third day for an 8-week period. Species diversity and population density determinations were made at 10 sites at three times during the testing period. Smaller macroscopic organisms were collected with a standard square foot Surber sampler and larger organisms with a seine. Species diversity and population density collecting sites were located at or near the water analysis sites so as to have a sound representation of the common macroscopic fauna of the streams in relation to the passage of time and shifts in the water quality (found to be especially dependent on rainfall). Every three days during the 8-week period, a precipitation record was made, and selected sites measured for total tons of acid flow.

Nine organisms were found in abundance in the unpolluted reaches of the streams sampled. They include *Salvelinus fontinalis* (brook trout), *Ephemeroptera sp*. (mayflies) *Desmognathus monticola* (seal salamander), *Oligochaeta sp*. (aquatic earthworms), *Dixidae* (diptera), *Cambarus sp*. (crayfish), *Anisoptera sp*. (dragonflies), *Tendipedidae* (midges) *Plecoptera sp*. (stoneflies), and *Trichoptera sp*. (caddisflies).

In the polluted sections, organism populations ranged from 0 to 4 in some abundance. They included *Dixidae*, *Tendipedidae*, *Plecoptera*, and *Trichoptera*. In some instances of less severe pollution, a fifth type, *Cambarus*, was present in some abundance.

Species diversity indices ranged from 0.00 (severely polluted region) to 2.32 (unpolluted area). The latter of these indices is a relatively low index for a nonpolluted stream, but this can be accounted for in terms of the naturally low fertility of the waters studied.

The second major approach to determining the effects of acid mine drainage was through tolerance limit investigations on four of the more abundant organisms found in the streams and the correlation of these data with information on water quality and species diversity collected on the streams. The organisms studied were *Salvelinas fontinalis*, *Cambarus bartoni robustrus*, *Desmognathus monticola*, and *Anisoptera sp*. Experimental variables in the tolerance tests were pH (sulfuric acid), iron, and total suspended solids. Aside from the tolerance limits established, the general observation after comparison with the study of the streams was that some species were absent from portions of the streams with water quality within their range of tolerance. This is an indication that the effects of pollution in the past (more severe than at the time the streams were investigated) are still present. The fauna of the area has not yet had time to completely return to its natural habitats.

An artificial stream tank was developed for use in the project to study the activities and habits of a population of crayfish under "normal" and suddenly polluted conditions.

After an intensive examination of the information produced in this study and from the observations, impressions, and knowledge obtained in gathering that information, the single general conclusion is that each coal mine or proposed coal mine must be considered individually. A thorough ecological, geophysical, and chemical study of the site must be made prior to the actual extraction of coal in order to determine the steps necessary to return the water quality of the area to its original state. A single law or regulation cannot govern the reclamation of all mining operations.

Reference copy: Annie Merner Pfieffer Library, West Virginia Wesleyan College

****

Mercury in the Benthos of Bellingham Bay, Washington (Grant no. GY-11459)

Western Washington State College
Bellingham, Washington 98225

June 24, 1974 - September 13, 1974

Participants:

Jennifer Andrews
Gary R. Graves
Kristine Holm
Howard Jones
James M. Nelson*
Janet M. Samples
Jennifer Specker
Joel Vecchione

*Student Project Director

Herbert W. Webber, Faculty Advisor

Between 1965 and 1970, from 10 to 20 tons of elemental and ionic mercury were discharged into Bellingham Bay with waste water from Georgia-Pacific Corporation's chlor-alkali plant, located at their pulp and paper mill industrial complex. It has been shown that elemental and ionic mercury can be transformed in sediments to methyl mercury. This form of mercury has been found to be concentrated in fish and it is toxic to people who eat the fish. Earlier studies indicated that much of the mercury from the industrial discharge was deposited in the sediment. One study demonstrated that the mercury is leaving the sediment at a much faster rate than expected.

The objective of our study was to learn what subtideal benthic organisms are found in Bellingham Bay and to ascertain whether they are accumulating amounts of mercury higher than natural levels. The following steps were taken to satisfy this objective: 1) determination of total mercury levels in

the organisms found in the sediments at the collection sites; (These data provided a base for determining if mercury was being concentrated in the food webs of Bellingham Bay).
2) determination of the distribution of subtidal macro-benthic organisms in Bellingham Bay and compilation of data for a species diversity index; (This work provided a scale on which to base the variety of the benthic fauna). 3) measurement of other environmental parameters in the bay (i.e., O_2, pH, SSL (spent sulfite liquors) salinity, and temperature) which influence organism distribution and the form of mercury present in the sediments and tissue.

Sample sites were selected along arcs drawn from the mercury source (the chlor-alkali plant) at Whatcom Waterway, extending to four kilometers into the bay, for a total of 28 sites in Bellingham Bay. Selected areas further away were also sampled for comparison. These included a site of the Nooksack River delta, and four sites from the mouth of Bellingham Bay to neighboring Samish Bay.

A Peterson-type grab, designed to sample a one-foot square area, was used to obtain three sediment samples for analysis at each site. Small representative portions of two grabs were analyzed for total mercury content and particle size distribution. The remaining sediment was then sieved to 1mm. mesh size to obtain the benthic organisms. At each station, oxygen, pH, temperature, depth, and SSL values were also determined.

Sediment analysis for particle size distribution and organic content was greatly influenced by the amount of bark, wood chips, and wood fibers in the sediment. These were present because of the pulp and paper industry wastes and the floating log storage in Bellingham Bay. Normal estuarian sediments were composed of 90% silt and only 10% sands and gravels. Wood chips and bark in many areas increased the coarse fraction to 10-50%.

Mercury content of sediments and tissues was determined on a Perkin-Elmer Atomic Abosrption Spectrophotometer, Model 306. Cold vapor (flameless) technique was employed, using compressed nitrogen gas as a carrier. The provisional method of the U. S. Environmental Protection Agency for mercury in the sediments and their method for mercury determination in fish were used. The additional step of using persulfate for extraction of mercury from methyl mercury compounds was followed.

Mercury levels in the top 7 cm. of sediment ranged from 58 ppm dry weight near the chlor-alkali plant, to background levels of 0.5 to 0.1 ppm dry weight at 1 to 4 kilometers from the source of industrial mercury. These background levels represent higher levels than are found in the sediments of neighboring bays. This is due to natural mercury deposits in the drainage of the Nooksack River, which empties into Bellingham Bay. However, this natural source of mercury is insignificant when compared with the industrial source of mercury.

Most of the benthic organisms were identified to species level. A mean mercury value of the tissues at each sample site was calculated by averaging the mean mercury levels of the dominant species (by weight) at each site. Mercury levels in the benthos of Bellingham Bay were found to be generally 0.1 ppm to 0.2 ppm wet weight. Control areas, in the bay but at a distance from the industrial mercury, had similar levels. This indicates that most sites which have a higher mercury content in the sediment do not reflect this in their tissue levels. Four sites did not have significantly higher benthic tissue levels. These include one area adjacent to the chlor-alkali plant, with 0.9 ppm mercury, and three sites adjacent to Squalicum Marina, ranging from one to two kilometers from the mercury source. These sites contained benthic mean mercury concentrations from 1.2 ppm to 2.7 ppm wet weight. These tissue values are much higher than adjacent sites having high sediment mercury levels. One possible explanation for this is increased methylation of sediment mercury due to contaminating ethyl-lead compounds. These ethyl-lead compounds could be derived from spilled gasoline in and around the marina.

A species diversity index for each site was calculated using the Shannon index. This index of species diversity ranged from none (0.0) to good diversity (2.3). Diversity within one-half kilometer of Whatcom Waterway was low to none. This area receives much industrial waste waters, mainly from the pulp and paper mill. These wastes create a high biological oxygen demand and unconsolidated anoxic sediments, which destroy the benthic habitat. Areas further than one-half kilometer from Whatcom Waterway had diversity values ranging from 0.45 (poor diversity) to 2.3 (good diversity).

An analysis of similarity of faunal types was also calculated.

A cursory analysis of bottom fish and crabs in Whatcom Waterway was undertaken. Analysis of 11 fish and crabs in this area, near the chlor-alkali plant, revealed none with mercury levels exceeding the FDA safety level for human consumption of 0.5 ppm. The muscle of one crab approached the safety level at 0.46 ppm wet weight.

It can be concluded generally that the benthic macrofauna of Bellingham Bay is not accumulating unsafe amounts of mercury in their tissues, when considering human consumption of the fish that feed on these organisms. However, the areas in Whatcom Waterway and adjacent to Squalicum Marina do appear to contain high levels of mercury. Fish feeding in these areas might exceed the FDA mercury safety level for consumable fish. The problem does not seem acute, but warrants further monitoring.

Reference copy: Western Washington State College Library

****

Baseline Study of Physical, Chemical, Biological and Socio-Economic Parameters of Navarre Beach (Grant no. GY-11416)

University of West Florida
Pensacola, Florida 32504

June 15, 1974 - August 31, 1974

Participants:

Teresa J. Daughdrill
Daniel G. Doughtie
Michael B. Given
Phillip A. Hastings

Victor Mitchell
Richard McLean
William B. Sutton, Jr.
Conrad B. White

Alice F. Long* James T. Winstead

*Student Project Director

Peggy A. Winter, Faculty Advisor

Bar built barrier islands parallel the northwestern coast of Florida for several miles. Santa Rosa Island extends from Pensacola to Destin, a distance of about 50 miles. Near the midpoint of the island is the community of Navarre Beach. There is great local interest in re-opening a pass through the island at this point to connect Santa Rosa Sound and the Gulf of Mexico. A pass was built there in 1965 but was not protected by jetties and so was closed by drifting sand within a few months.

This study was prompted by a desire to gather baseline information on the chemical, physical, biological and socio-economic environment of the area prior to the construction of the pass. These data could be useful in assessing the effect of re-opening the pass.

Thirteen water chemistry stations were established in the Sound in the area of the old pass. Samples of top and bottom water were collected from each station on 8 different days and analyzed for nutrient content. Field measurements were made of pH, salinity, conductivity, temperature and dissolved oxygen content. Total organic carbon and total inorganic carbon concentrations were measured with a Beckman 915 total organic carbon analyzer. Nutrient levels were usually quite low. Phosphates ranged from 1.3 to 27.1 ppb. Nitrates went from 0.000 to 0.059 ppm. Ammonia ranged from 12.3 to 34.6 ppb. Total Kjeldahl Nitrogen, from 221 to 934 ppb.

Conductivity, from 34.8 to 42.9 Ohms. Temperature varied from 26.2 to 29.6°C. Dissolved oxygen went from 2.6 to 6.2 ppm. Total inorganic carbon, from 16.0 to 20.4 ppm, and total organic carbon, from 6.5 to 10.6 ppm.

Water samples for bacteriological study were collected from two depths at five stations in the Sound on seven days. Total coliform organisms and total bacterial density were studied. The number of coliform organisms was quite low on most days. The average density was 50/100 ml, the maximum was 1600/100 ml. Total bacterial density averaged 27 cells/ml, except on one day when over 300 cells/ml occurred.

Five stations were used in the phytoplankton study. This involved the identification of the predominant genera, determining the chlorophyll content, determining the density or organisms, and making an investigation of the primary productivity of phytoplankton. Diatoms were the most numerous class of algae encountered. The genus, Rhizosolenia, accounted for 7.34% of the total organisms, while unidentifiable nannoplankton accounted for 73.29%. The general, Melosira and Navicula, were also common. Chlorophyll content of the Sound was quite high, as was the total cell density. The area appears to be quite productive, reaching a peak of primary productivity around the end of July when the average carbon fixation rate for the five stations was 35.8 mg $C/m^3/hr$. The north side of the Sound was significantly more productive than the south side. The intercoastal waterway, which is approximately 15 feet in depth is located at the northern side. Considerable organic debris is found in this channel in contrast to the clean, sandy bottom found in the more shallow, southern part of the Sound. Barge traffic may cause considerable mixing in the channel and thus contribute to the higher productivity. Another factor may be a run-off from a public park and an associated septic tank near the north end of the Navarre Bridge and the three small creeks draining into the area from the mainland. The southerly wind may be the most important factor in the productivity of the north side of the channel, as wind is known to concentrate phytoplankton.

Fishes were collected by seining, trawling, hook and line fishing, and setting gill nets. Species were identified by observation. The most common species in the shallow parts of the Sound was the pinfish, *Lagodon rhomboides*. In deeper waters of the Sound the Atlantic croaker, *Micropogon undulatus*, and the spot, *Leiostomus xanthurus*, were most common. In the marsh located in the old pass, the most common species were the sheepshead minnow, *Cyprinodon variagatus*, and the longnosed killifish, *Fundulus similis*, both members of the family Cyprinodontidae. Genera commonly found near shore in the Gulf of Mexico were *Menticirrhus*, *Caranx*, *Trachinotus* and *Scomberomorus*.

Benthic macroinvertebrates of the Sound were sampled with a diver-operated coring device designed and built by members of the study team. Cores were taken at each of the 13 water chemistry stations in the Sound. The most common species in the benthos of the Sound were the polychaetes, *Loimia viridis*, and *Mediomastus californiensis*. Very few mollusks were noted. Shorelines and pilings were also sampled qualitatively.

A study of the island vegetation, including that of the marsh, was made. The standing crop of the marsh in the area of the old pass was 508.3 g/m^2 on July 23, 1974. Some 45 species were collected and placed in the University of West Florida herbarium. A cross-island transect was studied for relative density and relative frequency figures. Another transect placed across the primary dune line was used to investigate changes in vegetation relative to distance from shore. The most important perennial on the primary dunes is sea oats, *Uniola paniculata*. Almost no trees were found on the Island near the pass.

Sediment cores were analyzed from 71 different locations in the Sound and Gulf at Navarre Beach. The sediments are probably derived from offshore and are well sorted. Sediments of the Gulf contain a slightly higher percentage of sand than those of the Sound. However, sediments consisted of more than 95% sand in both areas. The average grain size in the Gulf is slightly smaller, though both Sound and Gulf sands are classified as medium-grained. The area having the lowest amount of sand was at the mouth of William's Creek, where the percentage of sand was 23.72.

The currents in the area are heavily influenced by the tides at the mouth of Pensacola Bay. There is a net flow of water to the west though the direction of flow changes with the tides.

Microseston content of Sound waters averaged .0083mg/m^3, while that of the Gulf averaged .0006 mg/m^3 (less by a factor of $>$10).

In the socio-economic study, questionnaires were the primary means of assessing the community and its attitude toward the possibility of opening the pass. Of 462 people who responded to the question of whether or not they felt the pass would be economically beneficial to the community, 82% responded affirmatively. Sixty-seven and six-tenths percent of the 472 people who responded felt the pass would be beneficial to the local environment, while 9.7% felt it would be harmful. Demographic information, not previously available, was gathered by the use of interview and questionnaires.

It appears that the Navarre Pass will be built within two to three years. Hopefully, a follow-up study similar to our baseline gathering project will be made after the pass is built. It is expected that commercial development of the Navarre Beach area will be accelerated by the presence of the Navarre Pass. Hopefully, the increased population density will not have a deleterious effect upon the total environment. It remains to be seen whether or not sufficient measures will be taken to protect this area.

Reference copy: University of West Florida Library

****

Determination of Mercury in Marine Systems and Fishing Communities of Puerto Rico (Grant no. GY-11499)

University of Puerto Rico at Mayaquez
Mayaquez, Puerto Rico 00708

May 20, 1974 - August 11, 1974

Participants:

Susana E. Allongo-Lugo
Gilberto Arocho
Amarylis Cintrón
Eva L. Díaz
David Difré González
Samuel P. Hernández
Aarón Morales
George Otero, Jr.
Max Perez*
Daniel Pesante-Armstrong
Gloria I. Puebla-Melon
Hector Enrique Quintero
Sylvette Zaragoza

*Student Project Director

Manuel Rodriguez, Faculty Advisor

The presence of mercury in residents of fishing communities around the island of Puerto Rico was investigated. A relationship between mercury contamination of the marine environment and mercury found in the residents of nearly all fishing communities, as contrasted with mercury found in residents of inland areas, was sought. A total of about 2,500 samples was analyzed. Of these 435 were urine, 518 hair. The other 1,584 samples were distributed as follows: 208 coral, 491 algae, 475 sea water, and 410 sediments. The analysis method used was the following:

A wet digestion using sulfuric, nitric, acids and potassium permanganate was followed by a reduction with stannous chloride. The mercury was detected as elemental mercury using a Coleman MASS-50 Atomic Absorption Spectrophotometer from Perkin Elmer Corporation.

The results obtained were quite satisfactory. As expected, the inland areas exhibited the lowest mercury level. The average concentrations in this area were 3.36 ppm for hair and 12.6 ppb for urine. The highest mercury level in humans were found in Fajardo, in the eastern part of the island: 17.30 ppm for hair and 204 ppb for urine. The lowest level were found in Guanajibo, in the western part of the island: 3.98 ppm for hair and 17.2 ppb for urine. These results were in accordance with the frequency of consumption of sea food in those areas.

The marine samples showed a good correlation. A correlation between the mercury concentration in marine samples and in humans is difficult to establish because of the multiple variables involved. The mercury levels in sea water were homogeneous all around the island, showing just small variations due to the degree of contamination in the different areas. The lowest mercury concentration found in sea water was 18.6 ppb which represents six times the maximum limit extablished by the Environmental Quality Board of the Commonwealth of Puerto Rico for coastal waters. The maximum mercury level in sea water was found in Arecibo, in the northern part of the island: 56.0 ppb.

The statistical tests to which the results were submitted showed that these results are highly significant. Measurements with Standard Reference Materials, #1,571 from the National Bureau of Standards, showed a standard deviation of 0.09 (9%) in our analysis.

Cases where mercury concentration in hair was 15.0 ppm or higher were studied in more detail and compared with the total cases. This group reveals a higher frequency of sea food consumption, a preference for specific kinds of sea food, and a greater index of symptoms than the rest of the persons studied.

Our study does not reveal that the mercury level in Puerto Rico has reached a critical level at the present. A potential contamination problem may develop in the future if the appropriate regulations are not put into effect.

Reference copy: University of Puerto Rico at Mayaquez Library

****

Water Quality of Springs and Underground Streams in the Central Kentucky Karst (Grant no. GY-11479)

Western Kentucky University
Bowling Green, Kentucky 42101

May 6, 1974 - July 12, 1974

Participants:

Sherry Adams
Sharon Gosser
Michael A. Holmes*
Joe Kirchner

Jeb Pickard
Kelly St. Charles
John A. Settles
Robert Wilczynski

*Student Project Director

Non-Stipend Participants:

Rita Browning
Jonathan Woods

Donald R. Rowe, Faculty Advisor

The project had three principle objectives: (1) a water quality study of springs and underground streams in the Central Kentucky Karst; (2) a compilation of published and unpublished data on the occurrence of polluted water within the study area; (3) a collection of Federal and state regulations and court decisions relevant to the discharge of wastewater in Kentucky.

The study found that the major stream in Horse Cave is highly polluted, both biologically and chemically (specifically chromium). It was determined that almost all of the sample points were contaminated by fecal material and would be unsuitable for a water supply unless they are disinfected, prior to consumption (e.g., chlorination).

It was also found that pollution problems and episodes have and are occurring in the study area; it is also felt that many incidents are occurring and have not been cited.

A compilation of laws was completed; and it was found that laws are available which can be enforced to provide protection for groundwater supplies, as well as surface water supplies.

Reference copy: Western Kentucky University Library

****

Comparative Effects of Small Stream Effluents on Red Rock Reservoir Water Quality (Grant no. GY-11487)

Central University of Iowa
Pella, Iowa 50219

May 20, 1974 - August 9, 1974

Participants:

Mary Duggan
Mary Ettel
Jane Groen
Bob Groenendyk
Les Hook*

Jeff Lovell
Jane Lowe
Kris Nicholson
Jan Palmer
Tim Schipper

*Student Project Director

Mark Kennicker

Scot Swentek

Arthur Bosch, Faculty Advisor

Red Rock Reservoir is a U. S. Army Corps of Engineers project on the Des Moines River near Pella, Iowa. The dam was completed in 1969 and was designed for flood control and maintenance of downstream flow during periods of drought. The reservoir and adjacent land also serve as a wildlife refuge and recreational area. Throughout the study period, the dam was operated under flood control conditions.

This project proposed to determine the relative effects of effluents from two major sources on the water quality of Red Rock Reservoir. As major sources of effluents, the Des Moines River was compared with streams entering the reservoir from adjacent local watersheds. Established biological, chemical, and physical parameters were measured at stream effluences in the Des Moines River, and in the main reservoir and the results were compared. The measurement of pesticide residues was also attempted.

Ten sample collection sites were selected on the basis of their location with respect to the Des Moines River, the effluent streams of the local watersheds, and the permanent conservation pool. Some sites were selected specifically to replicate collection sites established during the 1973 SOS study. This provided a basis for a year-old comparison of the water quality.

Weekly samples were collected from three depths at each of the ten sites from May 21st to July 22nd. At each site the physical parameters of air temperature, Secchi disk, and water temperature at each depth were measured. Using a 1200 ml Kemmerer sampler, collections were made for phytoplankton and zooplankton counts and identification, dissolved oxygen (azide modification of the Winkler method), biochemical oxygen demand, and total coliform (Millipore standard technique, MF-Endo broth). A large sample for chemical analyses was taken and those tests performed on aliquots from this sample included carbon dioxide (titration), pH (potentiometric method), alkalinity (titration), orthophosphate (colorimetric technique), total phosphate (colorimetric), sulfate (turbidimetric method), ammonia nitrogen (direct Messlerization technique), Nitrate (modification of cadmium reduction method), nitrite (diazotization method-low range), total hardness (EDTA), calcium hardness (EDTA), and turbidity (colorimetric method). Water for pesticide analysis was obtained using the Kemmerer sampler in a semi-opened position to secure a mixed depth sample. Sediment samples for pesticide analysis, benthic analysis, and percentage of volatile solids determination were collected using a bottom sampling dredge. The analysis of liquid and sediment samples for pesticide residues was attempted using gas chromatography with electron capture.

The summary below gives the results (with ranges) found for various chemical and physical parameters.

PARAMETER	RANGE
Water Temperature	17.8 -- 29°C
Turbidity	1.0 -- 500 JTU
Light Penetration (Secchi)	0.15 -- 1.28 m
pH	7.15 -- 8.39 units

Carbon Dioxide	0.0 -- 11.8 mg/l $CaCO_3$
Dissolved Oxygen	1.0 -- 11.5 ppm
Biochemical Oxygen Demand	0.0 -- 7.0
Alkalinity	119 -- 235 mg/l $CaCO_3$
Total Hardness	120 -- 300 mg/l $CaCO_3$
Calcium Hardness	26 -- 320 mg/l $CaCO_3$
Nitrate	7.9 -- 44.0 ppm NO_3
Nitrite	0.03 -- 1.98 ppm NO_2
Ammonia Nitrogen	0.01 -- 1.0 ppm
Total Phosphates	0.0 -- 14.5 ppm
Orthophosphates	0.0 -- 1.2 ppm
Sulfate	40 -- 300 mg/l

Significant blooms were observed for the phytoplankters, *Actinastrum*, *Botrydiopsis*, and *Gomphophaeria*. The diatoms, *Ankistrodesmus*, *Navicula*, *Fragilaria*, and *Asterionella*, were all prevailing genera. Others commonly found included *Ulothrix*, *Chlorella*, *Oscillatoria*, *Pediastrum*, *Scenedesmus*, *Spaherocystis*, and *Tabellaria*, *Moina micrura* was the most common zooplankter. Others that were commonly found in samples were *Cyclops bicuspidatus*, *Bosmina coregoni*, *Bosmina longirostris*, and *Daphnia pulex*.

Total coliform counts were high at the outset of the project with counts of 1500/100 ml of sample very common. The lack of rain was probably responsible for the decrease in counts later in the project. Analysis for benthic organisms revealed that Dipera and Ephemeptera larvae were present at sites near effluent streams, with Chaborus and Tentans being most abundant. At the deeper lake sites, Oligochaeta and aquatic Annelids were collected. From samples taken with an artificial substrate sampler. Coleoptera and Dipera larvae were identified, with Anopheles the most abundant.

Analysis for possible pesticide residues was not completed satisfactorily because of malfunctions of the gas chromatograph. Thin layer chromatography did not provide the needed sensitivity and analysis with internal reflectance infrared spectroscopy was not successful.

The reservoir's water quality was diminished this year as compared with its quality during a 1973 SOS project. The reservoir was more productive in terms of an increased BOD and larger and more varied phytoplankton populations. Overall, major nutrient concentrations each year were similar. Sulfate concentrations did increase to over 250 mg/l, while orthophosphate concentrations decreased significantly. Turbidity readings were much higher and Secchi disk readings, as a measure of suspended solids, were much lower. Total coliform counts were much higher during a portion of the project.

In terms of the evaluation of the overall water quality, the assumption was made that the lower the values of water quality parameters measured, the higher the degree of water quality. Samples collected on days not immediately preceded by precipitation showed the samples from the river site had higher concentrations of two essential nutrients, sulfate and nitrate, and less specifically, alkalinity. A concentration of sulfate, nitrate, and alkalinity existed from the river site to a site in the reservoir near the dam. Concentrations in samples from stream sites were lower than those in samples from either the river or dam sites. Turbidity and Secchi disk readings improved as the distance from the river increased. With respect to the occurrence of organisms, there were some differences in benthic organisms present, due to differing substrata. Phytoplankton and zooplankton populations were similar at all sites. The river site contributed no greater numbers of coliform than any other site.

It should be noted that on sample days which were preceded by rain, the concentrations of nutrients in samples from all sites were nearly equal.

The tentative conclusion is that the river seems to have a greater negative effect on the water quality of the reservoir during the study period.

Reference copy: Learning Resource Center, Central University of Iowa

---

Water Quality Enhancement in a Sanitary Landfill Leachate Pond (Grant no. GY-11513)

Lowell Technological Institute
Lowell, Massachusetts 01854

June 3, 1974 - August 23, 1974

Participants:

Clifford Bruell
John Custy
Ehud Laska
Gary H. Laverty*
Robert Pelletier
Kevin J. Porter
Susan Stemporzewski

*Student Project Director

John C. Mallett, Faculty Advisor

A small pond adjacent to the incinerator-landfill operation in Lowell, Massachusetts, was investigated with essentially two objectives in mind. First, to determine if this pond was subject to leachate infiltration from the landfill, and if so, to determine the chemical and biological characteristics of this leachate. Second, to test the applicability of several methods of treatment for the removal of metals and suspended materials in the pond.

The red color of the pond water and the unpleasant odors arising from the pond sediments, suggested to us that it was receiving breakdown materials from the landfill. Data from well points drilled in the landfill area confirm that the groundwater slopes downward across the landfill, directly toward the pond. This groundwater enters the pond as a series of springs, some of which were observed and sampled on days of low water level. In addition, the pond receives waste effluent water carrying large amounts of fly-ash washed from the incinerator stacks.

Pond water samples were tested for DO, BOD, COD, total residue, ammonia nitrogen, calcium, acidity, and alkalinity, by methods described in Standard Methods. The heavy metals, iron, cadmium, zinc and magnesium, were tested by atomic absorption spectrophotometry. Samples were taken anaerobically from the surface and from the bottom (1.5m) of the pond. Testing was done several times weekly for the entire summer.

Average results for each parameter were compared to those values reported in literature values. For example, BOD and COD have been reported up to 750,000 mg/ℓ compared to 7.4 and 79.6 mg/ℓ in the leachate pond. Ammonia nitrogen was reported to range up to 850 mg/ℓ and alkalinity up to 8000 mg/ℓ , while these values in the leachate pond were 20mg/ℓ and 850 mg/ℓ . These differences can be explained in part, by the incineration process which serves to accelerate the breakdown or oxidation of waste materials.

Iron, an element usually found in high concentrations in sanitary landfill leachate, was also found in much smaller concentrations in the pond. However, metal analysis of pond sediments revealed high concentrations of iron, cadmium, zinc, and lead. Iron concentrations in the sediments averaged 85,000 ppm, while Cd values averaged 130 ppm. Thus, the pond acts as a trap for incoming leachate materials. This is due in part to the temperature stratification in the pond which divides the pond into an upper, oxygenated layer and a lower reducing layer. Dissolved metal compounds may be aerated at the surface, settle as insoluble oxidized compounds, and become trapped in the reducing sediment layer. Another contributing mechanism to this trap is biological precipitation. The plankton population absorbs metals, which then settle as organic complexes, as individual organisms die. This is evidenced by the high fraction of volatile residue in the sediment (67%).

Metals were also analyzed in water sampled directly from the leachate springs and from the incinerator effluent. From these results it was obvious that iron, for the most part, enters as leachate from the landfill. However, by statistical comparison, the source of cadmium and zinc in the pond seems to be the incinerator. Cadmium may be volatilized from the incineration of plastic compounds and thus become washed into the pond from the stack effluent. Because of its highly toxic properties, the presence of cadmium is a serious threat to the community.

Problems in the vicinity have been compounded by a rising ground water table at the incinerator site which has forced the city to pump water from the pond in order to prevent flooding of the incinerator. A pipeline carries this effluent to a wooded area which has subsequently developed into a polluted swampland. This, in turn, drains into the Black Brook, shortly before it enters the Merrimack River, a source of drinking water for several communities. Water and sediment samples from three additional sites were tested for BOD, COD and metals in order to determine the impact of the pond effluent on this system. The sites were located on the swampland area, and on the Black Brook, above and below the discharge point. Overall, the pond has a noticeable effect on the swamp area, but no observable effect on Black Brook, presumably because of the dilution effect, and because of the additional opportunity for materials to settle in the swamp area. This is evident from the high metal concentrations in the sediments of the swamp. The results also indicate a possible infiltration of landfill leachate directly into Black Brook at some point above the swamp area, since higher iron concentrations were found at the upper test site than at the other sites (4.3 mg/ℓ compared to 2.7 mg/ℓ).

The City of Lowell is concerned with the problem of leachate contaminants entering this wooded area. In this study, we tested the feasibility of in situ treatment by accelerating the settling process within the pond, thus preventing contaminants from leaving the basin. Various techniques were first tested under laboratory conditions using pond water samples. Lime flocculation in conjunction with aeration proved to be impractical, because of the large concentrations of lime required for effective removal of metals. We observed, however, that extended aeration, involving free mixing of air and water, increased the rate of settling by visibly precipitating the iron compounds.

The process of active reaeration is widely used in the treatment of wastewater, and thus its application to the treatment of leachate diverted to a surface basin was attempted.

Experiments were carried out in the pond using several static mixer type aerators installed in the deeper zone of the basin. Air was introduced into these aerators from a compressor and allowed to mix with the water as it passed through a series of baffles. The aerators also served to uplift the bottom layers, allowing reaeration through the resulting surface boil. These attempts at enhanced oxidation and precipitation in the pond met with limited success, as indicated by monitoring of iron and by measurements of DO and temperature. The major problem results from the difficulty in overcoming the pond which was continually reinforced through surface heating and inflow of cold spring water at the bottom.

A more practical solution would be to divert the pond water through the present pumping system into the municipal wastewater treatment facility currently under construction. Coliform counts of up to 30,000/100ml in both Black Brook and the pond indicate the need for sewage tie-ins to the incinerator and to several residential areas, whose specific facilities apparently are contaminating surface water and groundwater in the area. The coliform counts also provide an indication of the ability of the pond water to support microorganisms, a critical requirement in this treatment process. The low BOD and COD levels found in the pond indicate that pond water would impose a minimal burden on this type of treatment system, thus further supporting this proposal. However, the effect of the high concentrations of heavy metals may be detrimental and this aspect is presently under investigation by a team member.

Reference copy: Library, Lowell Technological Institute.

****

The Cycling of Co, Cu, and Ni in a Small, Forested Watershed

(Grant no. GY-11449)

Johns Hopkins University
Baltimore, Maryland 21218

May 27, 1974 - August 16, 1974

Participants:

Richard B. Beach
Ruth E. Braun
Maurice A. Cucci
Mary E. Daniel
Margaret R. Michalek*
Randall C. Ross

*Student Project Director

Owen C. Bricker, Faculty Advisor

This study was originally planned to answer the following questions:

(1) What are the total concentrations of Co, Cu, and Ni to be expected in the streamwater, suspended sediment, channel sediment, soil water, forest litter (A-0 soil zone), humus (A-1 soil zone), leached soil zone (A-2 soil zone), B soil zone, C soil zone, and groundwater of a forested watershed?

(2) What is the predominant form (i.e., adsorbed by clay minerals, adsorbed by organic material, etc.) in which these trace metals are held in and/or transported through the watershed for each type of particulate matter sampled (i.e., suspended sediment, channel sediment, and each of five soil zones)?

The water shed chosen for this study was the Pond Branch Watershed located approximately eight miles north of the Baltimore City line. It consists of 95 acres and is forested except for three acres which were cleared in 1967 for the construction of a pipeline. The watershed is underlain by one bedrock type, the Wissahickon schist, and has been the site of a study of major ion cycling.

Because of analytical problems and sampling errors, neither question could be answered completely. The first question could not be answered completely because of the following problems or mistakes: (1) The low concentrations of Co, Cu, and Ni in the streamwater were difficult to detect; (2) The stream gauging unit did not operate properly; (3) Soil and stream sediment samples had not been homogenized before subsamples were chosen for different analyses, such as analyses for total concentration of Co, Cu, and Ni, and for factors which affect the distribution of Co, Cu, and Ni, such as the concentration of iron and manganese oxides, etc.

The streamwater analysis for Cu can be summarized as follows. Streamwater samples were filtered with a .22μm Millipore filter. The trace metal was concentrated into a smaller volume by means of solvent extraction. Ammonium pyrrolidine dithiocarbamate was used as the chelating agent and methyl isobutyl ketone was used as the solvent. The terminal analysis was done on a Perkin-Elmer Model 403 atomic absorption spectrophotometer. All materials that came in contact with the water samples, whether glassware, sample bottles, or reagents, were thoroughly cleaned. It was found that concentrations of Cu near 1 ppb were being leached from the Millipore filters. To avoid this source of contamination, the filters were soaked in 2.5% acetic acid and then in double-distilled deionized water before use. A blank, which consisted of double-distilled deionized water was run with each sample through the entire analysis and served as a correction for any source of contamination that our cleaning and purifying steps had not prevented. This method yielded reproducible results for Cu with a detection limit of 1 ppb. Reliable data were obtained only for Cu, since many problems arose during the terminal analysis of Co and Ni. On three sampling dates for which our most improved method of analysis was used, Cu concentrations in the streamwater were less than 1 ppb. From data collected in June it was found that Co and Ni concentrations in the streamwater were each less than 10 ppb.

In order to answer the second question, the methods of McLaren and Crawford (1973) were followed to extract Co, Cu, and Ni from various sites that the trace metals could occupy in the soil and stream sediment of the Pond Branch Watershed. The general format of the extraction procedures was as follows. A portion of a dried soil or stream sediment sample was taken, .05M calcium chloride added, and the mixture shaken for 24 hours. The supernatant solution was analyzed by atomic absorption spectrophotometry to obtain the concentration of Co, Cu, and Ni in solution and on exchange sites. This is termed the "CA" extraction. The residue was saved, 2.5% acetic acid added, and the mixture shaken for 24 hours. The supernatant solution was then analyzed to obtain the concentration of Co, Cu, and Ni adsorbed on clay minerals plus part of that adsorbed on organic matter and on iron and manganese oxides. This is the "AC" extraction. The residue from this extraction was then discarded. Another portion of dried soil or stream sediment was shaken with 1M potassium pyrophosphate to extract more completely the Co, Cu, and Ni adsorbed by organic material. This is termed the "PYR" extraction. The residue from this extraction was in turn treated with oxalic acid and ammonium oxalate under ultraviolet light to extract the Co, Cu, and Ni occluded by iron and manganese oxides. This is called the "OX" extraction. The residue from the OX extraction was then treated with concentrated hydrofluoric and nitric acid to extract Co, Cu, and Ni from within mineral lattices. This is termed the "RES" extraction.

Many problems were encountered in the terminal analysis of the PYR extraction, which ranged from clogging the burner of the atomic absorption unit to not being able to find appropriate internal standards. Assuming that the potassium pyrophosphate did extract what it was supposed to have extracted, data from the OX and RES extractions can be salvaged.

The soil sampling proceeded as follows. Four soil profiles, each at a different elevation on a hillslope, were sampled at five different depths. The sampling and analysis of particulate matter was not thorough enough to yield any conclusions with regard to: (1) changes in concentration of Co, Cu, and Ni in the various extractions with depth in the soil profile; (2) comparison of the behavior of Co, Cu, and Ni; (3) distribution of Co, Cu, and Ni in the stream sediment as compared to their distribution in the soil. However, several generalizations can be made. Although the CA and AC extractions required one subsample and the PYR, OX and RES extraction data seems to justify a comparison of results from these four extractions.

It appears that the predominant site occupied by Co, Cu, and Ni in the soil is that within mineral lattices. The RES extraction yielded the highest concentration of Co, Cu, and Ni and the OX extraction yielded the second highest concentration. This result is corroborated by a study of 24 top soil samples from different soil types in Scotland (McLaren and Crawford, 1973, p. 177) and by a study of stream sediment from the Amazon and Yukon Rivers (Gibbs, 1973, p. 180). The study shows that for the Pond Branch Watershed a very small concentration of Co, Cu, and Ni exists in the streamwater as compared to the concentration of Co, Cu, and Ni held in mineral lattices and occluded by iron and manganese oxides in the soil.

Reference copy: Milton Eisenhower Library, Johns Hopkins University

****

An Environmental Study of the Vermilion River (Grant no. GY-70501)

University of Southwestern Louisiana
Lafayette, Louisiana

May 20, 1974 - August 12, 1974

Participants:

Michael Alexander	Danny Landry
Bernard Bonnecaze	Marcus J. Landry
Regis Burgert	Tommie J. Laughlin
Gary Duncan	Gail T. Qualls
Linda S. Eyster*	Stephen Sobek

*Student Project Director

John Hardee Paul Wiggins

Davy L. Bernard, Faculty Advisor

The Vermilion River is a small, winding stream flowing through south central Louisiana. Bayous Carencro and Fuselier converge 13.0 km north of the city of Lafayette to form the Vermilion's headwaters. From this point, the river proceeds in a southwesterly direction for 110 km, terminating at Vermilion Bay on Louisian's south coast.

Lafayette, the largest city directly on the river, is the center of the state's off-shore petroleum activity. The major industries along the river include meat processing, cane syrup producing, boat building, oil and gas producing, canning, and animal rendering. These concerns utilize the river as a means of navigation and of waste disposal. Municipalities utilize the river mainly for the disposal of both treated and untreated sewage. Although public water supplies are being obtained from groundwater, there is concern that encroachment of river water into the groundwater supplies has occurred through the bed of the stream which is connected to the principal aquifer near the mouth. Because of such disposal activities, use of the river for water sports cannot presently be santioned because of the potential health hazard. The river, in fact, fits the description of a slow moving effluent depot with obnoxious odors especially noticeable after heavy rains.

At the beginning of our study we believed the three main problems plaguing the Vermilion River to be industrial and municipal pollution, salt-water intrusion from the bay, and deficient flow. Our primary purpose in this study was to determine the presence of and actual amounts of specific pollutants in the river. We also routinely tested for the presence of salt water and measured flow speeds.

During the first week 44 sites were sampled by boat in the area from 93.5 km to 31.0 km above the mouth. All samples were taken at a depth of 1.5 meters with a Kemmerer water sampler. From these 44 sites, 18 were selected as our established sampling sites. These sites were sampled a minimum of 14 times each (every four days) during the remaining sampling period. Sampling runs were also made twice to the headwaters and twice to the mouth of the Vermilion River. All analytical procedures were modeled after *Standard Methods for the Examination of Water and Wastewater*, 13th edition.

Ranges of the average site values for the chemical and physical parameters are summarized below:

water temperature	26.4 - 27.7°C
dissolved oxygen	2.65 - 4.03 ppm
percent O_2 saturation	32.6 - 49.4%
chemical oxygen demand	19.3 - 240.6 ppm
turbidity	107 - 202 FTU
specific gravity	.9917 - 1.004
flow	.029 - .260 mps
chlorides	40.1 - 52.4 ppm
pH	6.9 - 7.0
acidity	10.2 - 12.4 mg/ℓ $CaCO_3$
alkalinity	53.8 - 66.6 mg/ℓ $CaCO_3$
nitrates	less than 2.0 ppm

total phosphorus	1.0 - 3.4 ppm
arsenic	less than 0.3 ppm
strontium	90 - 100 ppm

It was concluded that:

I. The DO concentration is below the recommended level throughout the river;

II. Phosphate, nitrate and arsenic concentrations are all within allowable limits;

III. No significant salt water intrusion from the bay occurred during the study;

IV. Land runoff into the river due to rains is considerable, as evidenced by the increase in turbidity readings;

V. There was no significant spatial or temporal variation in pH in the river. Alkalinity, acidity, and pH tests unexpectedly indicated no harmful acidic or basis imbalances;

VI. A substantial amount of organic dumping is occurring in and south of Lafayette, as supported by DO and COD test results;

VII. According to minimal testing by x-ray fluorescence and neutron activation analysis, no dangerous levels of heavy metals presently exist in the Vermilion River.

The biological testing in this project included a benthic macroinvertebrate and partial microinvertebrate study, a macroinvertebrate and partial microinvertebrate analysis of organisms obtained from artificial substrate samplers, a light-and-dark bottle productivity brief to determine factors of river metabolism, a productivity study based on round-the-clock dissolved oxygen concentrations, and a determination of the biological oxygen demand (BOD) of the river.

These tests provided the following ranges and conclusions:

BOD	1.75 - 5.44 ppm
Oligochaete count (dredge)	44 - 24,593 i/m^2*
Oligochaete count (artificial substrate sampler)	24 - 4,445 i/m^2
Chironomid count (dredge)	119 - 3,096 i/m^2
Chironomid count (artificial)	601 - 2,381 i/m^2
Diversity (dredge)	.152 - .664**
Diversity (artificial)	.183 - .564

*individuals per square meter ** Shannon diversity

I. The dominant benthic taxa in the river are pollution tolerant;

II. The most suitable conditions for oligochaete growth were located at kilometer sites 82.5 and 81.4 (Lafayette), 69.8 (halfway between Lafayette and Milton), and 61.3 (Milton);

III. Low gross primary production occurs in the near-surface river community, as indicated by river metabolism studies;

IV. Organic pollution is lowest north of Lafayette and increases with additional municipal and industrial dumping downstream as the river passes through Lafayette, Milton, Abbeville, and Perry, Louisiana.

The geological part of the project involved investigation of sedimentation patterns, sediment particle size distribution, and dissolved and suspended particulate load analyses. It was found that:

I. The median grain size of sediments ranged from .0118 to .0759 mm;

II. Although the turbidity in the Vermilion River is the result of dissolved and suspended particles, the quality of material in suspension and in solution is too varied at different points in the river to allow the use of turbidity readings as an accurate test for either dissolved or suspended materials;

III. Differences in channel width influence sedimentation in the Vermilion River. Where the river channel is narrow, fine grained sediments which accumulate during low flow periods are flushed out when normal flow is restored. However, where the channel has been widened by natural erosion and/or dredging operations, the velocity of the river is slower and sediments which accumulate during low flow periods cannot be removed by normal flow. (Dredging of the Vermilion River has occurred in 1896, the 1940's, and 1953.)

Microbiological investigations into the river indicated that large amounts of insufficiently treated sewage are reaching the river. The fecal coliform MPN ranged from 2992 to 14,428/100 ml. (The maximum allowable fecal coliform content for the Vermilion River is 200/100 ml.)

Our study has revealed that the Vermilion River is still grossly polluted, particularly with insufficiently treated human wastes. Of the three main problems we believed were plaguing the river, pollution, salt-water intrusion, and deficient flow, we found only the first and last to be of significance. The pollution could be partially abated through stringent enforcement of rigid anti-pollution laws. This, of course, would mean added expenditures for treatment by municipalities and individuals. Even that, however, would not guarantee a solution as matter (plant and animal) from watershed run-off after heavy rains is more than adequate to increase COD and BOD.

At this point, dredging the river to increase water flow would seem logical. This has to be weighed against possible salt water intrusion; furthermore, it is not clear that dredging the Vermilion will increase the river's flow satisfactorily. Therefore, we are left with one alternative; to introduce water into the Vermilion via the Atchafalya Basin.

Reference copy: Dupre Library, University of Southwestern Louisiana

****

A Comprehensive Study of the Lower North and South Santee Rivers: A Deltaic Lobe in a Destructive Phase (Grant no. GY-11540)

College of Charleston
Charleston, South Carolina 29401

June 1, 1974 - August 1, 1974

440.

Participants:

Chevis D. Clark	William E. Knebusch
Margaret W. Cooper	Francis K. Leseane
George W. Eyer	Melissa A. Sandstrom
Michael A. Johnson*	Mary L. Sloan

Hala W. Wilson

*Student Project Director

Non-Stipend Participants:

Robert J. Bascle	Mark S. Cable

Daniel G. Stephens, Faculty Advisor

The Santee River System, the third largest on the east coast of the United States and one of the most productive for hydroelectric power, has recently been the subject of much controversy. In 1942, construction of the Santee-Cooper hydroelectric project on the upper Santee River resulted in the diversion of 14,000 sq. mi. of the Santee drainage basin through the Cooper River to the Charleston Harbor. Effects of this project on both the Santee and Cooper Rivers were drastic. Reduction of fresh water discharge from 540 m^3/sec to only 14 m^3/sec and annual sediment discharge from 10^6 tons/year to 10^5 tons/year resulted in a local marine transgression in the lower Santee distributary complex. Increase in water discharge and fine sediment output resulted in increased silting in Charleston Harbor on the order of 90 to 150 times. To correct these problems, the Army Corps of Engineers proposed in 1966 to redivert waters from Lake Moultrie reservoir on the Cooper River back down the Santee River, thus establishing fresh water discharge in the Santee to approximately 80% of historic levels. The purposes of the Coastal Studies Group were four-fold:

1) to determine the nature of prediversion environments in the lower North and South Santee estuaries;

2) to determine to what extent these environments have been affected by diversion;

3) to provide information for comparison to post rediversion Santee;

4) if possible, to make general predictions as to the probable effects of rediversion on the lower Santee estuaries.

This study consisted of six major approaches; comparative geomorphology, analysis of barrier beach facies, bathymetry, hydrography, analysis of benthic fauna, and stratigraphic relationships.

Comparative geomorphology consisted of obtaining a complete collection of charts and maps dating from 1870 to the present. From these, it was observed that, prior to 1942, the Santee River Delta was in a progradational or constructive phase. After 1942, charts show the barrier beach facies undergoing a destructive phase as evidenced by major erosion of spits and inlets.

The barrier beach facies was thus analyzed in greater detail by the establishment of 14 beach profiles. Although profiles were run only three months, it was possible to designate areas as erosional, stable, or accretionary. Major erosion most frequently occurred within the inlets and on the seaward side of spits. Stable areas were restricted primarily to the centers of large islands. Accretion occurred on the points of spits as a result of sediment accumulation through wave refraction.

Hydrographical conditions were found to be dependent upon a number of variables: morphology, bathymetry, fresh water discharge, tidal flow, and wind direction. Although only five hydrographic stations were monitored, a number of basic conclusions were reached: 1) salinities and temperature are generally higher in the South Santee River than the North Santee River due to a greater marine influence; 2) under normal flow conditions both estuaries may be classified as partially mixed; and 3) major channels in both the North and South Santee appear to be ebb tidal dominated.

In order to understand the nature and distribution of benthic organisms better and thus to provide a basis for comparison with underlying biostratigraphic units, samples were taken at 84 locations within the lower North and South Santee estuaries. Greatest diversity was observed to be primarily a function of bathymetry and salinity, occurring in the deep channels near the mouths of both rivers. Certain organisms were found to be indigenous to specific environmental conditions. The small pelecypod, Tellina alternata, the carnivorous gastropod Retusa canaliculata, and the small pelecypod, Donax variabilis, were found in greatest abundance in areas of high salinities, high current velocities, and marine sands. The large American oyster, Crassostrea virginica existed in greatest abundance in estuarine conditions of moderate salinities and was present in both inter-tidal and subtidal environments. Most often associated species were Odostomia impressa, a small ectroparasitic gastropod, the filter feeding pelecypod, Brachidontes sp., and the gastropod, Urosalpinx cineroa. Organisms in fluvial channel sand or clay environments were almost entirely lacking. Thus three main biofacies existed: marine, estuarine, and fluvial.

Core samples taken at 35 locations permitted the reconstruction of ancient environments. Facies were distinguished on the basis of both sediment and faunal characteristics and counterparts of all recent environments were distinguished in the stratigraphic record. Cross sections drawn between core sites enabled a number of conclusions to be reached:

1) Marine sands are presently migrating up the estuary into previously fluvial or estuarine environments;

2) The Coriolis effect is of major importance, since marine sands generally occur near the right-hand river banks as one looks up the estuary;

3) Pre-diversion bathymetry roughly coincides with the lower contact of the marine sand sheet;

4) Underlying oyster reefs were not in all cases destroyed as a result of the river diversion;

5) Main river channels have been relatively stable over the last 4400 years;

6) Extent of marine penetration in the South Santee River is much greater than in the North Santee, owing to a much lower fresh water discharge in the South Santee.

In general, it appears that diversion has been the major source of the problems in the lower Santee estuaries.

Although it is difficult to say exactly what will happen in the deltaic complex when rediversion occurs, it appears that sediment output will not increase in equal proportion to fresh water discharge. Large oyster reefs in the estuaries may be destroyed and bank erosion may increase. In order to accommodate a tremendously greater fresh water discharge, channel migration or expansion may occur, resulting in serious morphological changes to the area's barrier beach ridges and marshlands.

Reference copy: Robert Scott Small Library, College of Charleston

****

A Study of the Effects of Zinc Smelter Emissions on the Town of Palmerton, Pennsylvania (Grant no. GY-11490)

Lafayette College
Easton, Pennsylvania 18042

June 16, 1974 - August 16, 1974

Participants:

Gary C. Cassel*	Catherine A. Patterson
Patrice Cassidy	Richard C. Redline
Coleen S. Craven	William Sandilos
Gary Huber	Robert Simon
Robert I. Leighton	Allen C. Smith

*Student Project Director

G. Earl Peace, Jr., Faculty Advisor

Palmerton, Pennsylvania was founded in 1898 by the New Jersey Zinc Company, and was named after S. S. Palmer, the President of the company. This particular site was chosen for construction of the zinc smelter because it offered room for expansion, a source of water (the Lehigh River) and was also close to the coal mines which supplied fuel for the plant. The West Plant began operations in 1898, while the East Plant began operations in 1910.

In an average month, the Palmerton operations of New Jersey Zinc produce 9,000 tons of zinc and zinc products, 7,500 tons in the form of ZnO. The roasters process about 550 tons of ore concentrate per day at about 1000°C., which converts sulfur to SO_2, but also volatilizes zinc (b.p. 907°C) and cadmium (b.p. 765°C). The majority of the zinc and cadmium which previously escaped into the atmosphere is now captured by electrostatic precipitators.

The emissions from the Palmerton operations have led to noticeable damage to the environment, particularly a denudation of surrounding areas in the immediate vicinity of the plants. There has been much additional speculation as to the possible existence of other less evident effects. The primary purpose of this project was to begin to gather baseline environmental data so as to provide an objective look at both the long-term and short-term problems and their proposed solutions.

It was decided to concentrate on three areas: soil, water and plants. The soil was studied to determine the microorganisms present, the levels of heavy metals present, and the geology. Six bacterial populations which were isolated were classified as being of the genus, Pseudomonas, while the seventh was of the genus, Flavobacterium. Not surprisingly, all of these bacteria were found to be highly resistant to large concentrations of zinc oxide, ranging up to 600 g. of ZnO in 1000 ml. of medium. Actinomycetes, an important bacterial agent of decay, was absent from several of the soil sites. The elements, lead, copper, cadmium and zinc were all found to be present in extremely large concentrations in the soil samples.

A direct correlation was found between the concentrations of these heavy metals in the soil and the concentrations of these heavy metals in the soil and the concentrations of these same elements found in plant samples taken from the same sites. It was not possible to determine, however, whether these metals were adsorbed onto the surfaces of the plants, were present within the tissues of the plants, or both. The concentrations of the metals, potassium, calcium, magnesium and iron, all of which are important in floral nutrition, appear to be adversely affected in some cases, by the presence of large amounts of these heavy metals.

The water analyses included a study of the concentrations of seven of these same elements (Cu was omitted) in various stages of the hydrologic cycle. The highest concentrations of zinc were found in the first 1/8" of precipitation collected during a storm, and in the soil water, but were not found in the first precipitation samples collected. These data support the results of the geologic soil analysis which showed the presence of from 1.0 to approximately 7.0% clay in the various soil samples. Clay is capable of adsorbing considerable quantities of metallic ions, which may then be dissolved in and exchanged with the large amount of water present in these soils.

The water and sediments of the Aquashicola Creek were analyzed for various chemical characteristics including the aforementioned eight metals at each of eight sites. Zinc, potassium, calcium and magnesium all show marked increases between site 1 and site 7. Cadmium, iron and lead show small but significant increases over these same sites, but copper remains below the detection limit. These and other chemical changes in the creek are attributable to the effluents and indirect effects of the New Jersey Zinc Company. The data obtained at site 8, however, seem to be indicative of the formation of a recovery zone, presumably the first tangible results directly attributable to pollution control efforts by the company.

Reference copy: Skillman Library, Lafayette College

****

The Effects of Acid Mine Drainage on Lake Hope (Grant no. GY-11431)

Wright State University
Dayton, Ohio 45431

June 10, 1974 - August 31, 1974

Participants:

Jill W. Ackerson
Denise A. Bierley
Jerry E. Boller
Andrew Y. Chao
David M. Haile
George E. Heckman
Brent E. Huntsman
John T. Lillie
William K. Maxfield
Joseph G. Solch

David A. Harlow
Beverly J. Warner*

*Student Project Director

Non-Stipend Participants:

Margaret S. Chao
H. Patrick Covault
Jeffrey T. Pender
Denise A. Rossi
Rudolph M. Schuller
James T. Townsend
Daniel R. Viste

Michael J. Smith, Faculty Advisor

Water pollution by acid mine drainage presents a serious and immediate problem to natural water systems in Appalachia. The Appalachian Regional Commission Report (U.S. Army Corps of Engineers, 1969) states that streams in the Appalachian region receive in excess of 6,000 tons of acidity daily from abandoned coal mines. The report also estimates that over 10,000 miles of streams have been affected by acid mine drainage, with 63% of the streams originating from abandoned drift and shaft mines.

The State of Ohio is typical of the Appalachian states in that a great number of sites throughout the state suffer from the effects of acid mine drainage, including state-owned lands. This situation is typified in Ohio by the drainage in which Lake Hope is situated.

Lake Hope is a state-owned recreational lake with 125 surface acres and 5.4 miles of shoreline, located in Brown Township, Vinton County, Ohio. The lake is situated approximately 20 miles west of Athens, Ohio within the Zaleski State Forest. The main stream flowing into Lake Hope is Sandy Run, which in turn has a number of smaller tributaries draining into it. Lake Hope itself empties into Raccoon Creek, a tributary of the Ohio River.

The Lake Hope Drainage Basin was an excellent site for studying the effects of acid mine drainage on a natural environmental system. More than 107 abandoned mines that dump a yearly average of over 700,000 pounds of acid drainage into Sandy Run have been located in the area. Most of the mining in the Lake Hope basin has been of the drift or slope type, with little strip mining undertaken. The major mine complexes have been located in a portion of the Lake Hope drainage basin that drains directly into Sandy Run.

To properly document the effects of acid mine drainage on the Lake Hope watershed, it was necessary to institute a comprehensive investigation of the factors influencing the production of stream contamination. This study, therefore, emcompasses three major areas of concentration: biology, geology, and chemistry.

The biological study comprised two main subsections. One was a general classical survey of the periphyton, invertebrates, and aquatic flora found in Lake Hope and in Sandy Run. The second section centered on the cultivation and isolation of Thiobacillus ferrooxidans, an iron-sulfur oxidizing autotrophic bacterium commonly found in acid mine drainage systems.

T. ferrooxidans is believed to participate in the production of acid mine drainage by utilizing the energy derived from the oxidation of Fe(II) to Fe(III) for metabolic processes. In catalyzing this reaction, T. ferrooxidans ultimately enhances the dissolution of pyrite, the source of acidity and iron found in coal mine drainage waters.

T. ferrooxidans was successfully cultivated, utilizing plating techniques developed during the course of the project. Viable cell counts in the acid mine drainage waters within the Lake Hope drainage basin were made.

The major area of focus for the geological study included a complete hydrologic budget of the Lake Hope watershed, completed through the installation of a weather station, two well-level recorders, seven rain gauges, and a recording evaporimeter. A comparison of the Lake as it appeared when first established in 1937 and as it appears today was accomplished by mapping the existing lake bottom, and applying computer techniques to determine the difference in lake bottom contour elevations. The geology group also sampled representative portions of the Middle Kittanning No. 6 coal seam exploited during mining operations in the Lake Hope area, and the surrounding bedrock. The mineral content of these samples was determined by X-ray diffraction.

The third component was a general chemical survey of the water and sediments found in the drainage basin. Each water sample collected was analyzed on site for acidity, chlorides, iron(II), nitrates, phosphates, sulfates, pH, and dissolved oxygen.

Although pH is not directly related to acidity, waters with high acidity are generally those with lower pH values. Usually, the solubilities of trace metal contaminants are found to increase with decreasing pH. The low pH levels found in acid mine drainage waters often result in high metal loading in these waters, with the exact concentration dependent upon the chemical composition of the coal and surrounding bedrock. For this reason, a major portion of this study involved the analysis of water and sediment samples for metal contamination resulting from the presence of manganese, copper, zinc, cadmium, and mercury. In addition, analyses for total soluble iron, calcium, and magnesium were carried out. From these tests, an overall assessment of water quality within the drainage basin was made. The metal analyses of sediment samples were used as indicators of the amount of residual contamination in local stream beds.

Reference copy: Wright State University Library

****

The Effect of Industrial Pollution on the Loosahatchie River Ecosystem (Grant no. GY-11500)

Southwestern at Memphis
Memphis, Tennessee 38112

June 3, 1974 - August 28, 1974

Participants:

Steve Bills
Helen Broom
Janice Hyatt
Jill Johnson
Randy McKenzie
Sharon Meador*

Bevester Paige
Russell Ries
Cecelia Schardt
Linda Smith
Gary Waldrip
Julia Walker

*Student Project Director

Lee Ann Woodward

Bobby R. Jones, Faculty Advisor

The Loosahatchie River originates in Central Tennessee, flows westward, and empties into the Mississippi River at the Northern boundary of Memphis. Industrial pollution is present in the lower 15 miles of the Loosahatchie. The major industries involved are W. R. Grace Company and E. I. DuPont de Nemours and Company. The principal waste product from these industries is ammonia. In September 1974, both Grace and DuPond diverted their waste into the Memphis City Sewer System.

The purpose of our study was two-fold: to determine the effects of ammonia and nitrate on two aquatic organisms, and to determine the suitability of the Loosahatchie River for aquatic life. The results of this project will be available for use in studying the recovery of the Loosahatchie River ecosystem after the removal of industrial pollution.

The laboratory tests with Ictalurus punctilus showed that catfish can become acclimated to high levels of ammonia in their surroundings. When the level of ammonia is slowly increased over a period of weeks, the LD_{50} is reached at 68 ppm ammonia. Sudden drastic increases in the ammonia level result in a LD_{50} at 42 ppm ammonia. In both cases, catfish are extremely susceptible to all types of shock at ammonia levels higher than 15 ppm.

The correlation between nitrite concentration in the water and percent methemoglobin in catfish was also studied. The percent of methemoglobin increases as the level of nitrite increases. At 50 ppm nitrite, the methemoglobin level is 96% and a LD_{50} occurs.

Other tests with Ictalurus punctilus show that the amount of ammonia secreted by fish when placed in clean water increases as the ammonia level in the holding tank increases. These results could conceivably be used to develop a quantitative method for determining the stress level of fish.

Experiments with Chlamydomonas rheinhardii show that ammonia levels effect algal populations. At molar concentrations of .01 or less, ammonia causes an increase in respiration. At ammonia levels greater than .02 molar, respiration decreased. Thus, at low concentrations, ammonia has a stimulatory effect on algae, while higher concentrations of ammonia have an inhibitory effect.

The water quality of the Loosahatchie River was studied at four sites. Site I was above both Grace and DuPont; site II was between the two industries; site III was below both industries; site IV was two miles downstream from site III.

Although the industrial pollutants never reached a lethal level, stress levels of ammonia did occur during the summer of 1974.

Fish population studies indicated a decrease in the fish population since 1952. Utilizing a method which was successfully used in 1952 to indicate a high diversity in the fish population, no fish were captured during the period of the 1974 study.

While industrial pollution probably contributed to the decline in fish populations, there are other factors involved. Much of the Loosahatchie River's upstream flood plain has been cleared for agricultural use. The runoff from this cleared land, the high turbidity of the river, the large and sudden fluctuations in the water level, the lack of a stable shallow water zone, and increased sewage discharges are all factors which would tend to curtail aquatic life.

Given the other deleterious factors present in the Loosahatchie River, it is unlikely that industrial pollution alone caused a decrease in the fish population. Studies of the river, now that industrial pollution has been removed, may show how much effect DuPont and Grace had on the ecosystem.

Reference copy: Library, Southwestern at Memphis

****

Water Quality in the Mid-Hudson Region of the Hudson River

(Grant no. GY-11505)

Marist College
Poughkeepsie, New York 12601

July 5, 1974 - September 10, 1974

Participants:

Joseph A. Abys
Virginia R. Albano
Harold M. Gerdes*
Louis C. Graziano
Michael W. Pantoliano

James W. Pierson
Peter R. Pless
David M. Prishtash
Jeffrey R. Shuster
Patricia M. Tillou

*Student Project Director

Malvin J. Michaelson, Faculty Advisor

This project entailed the acquisition of quantitative data on essential environmental parameters of the Hudson River. These attributes include concentrations of nitrates and phosphates, together with concentrations of heavy metals in water, examinations of sediments and descriptions of benthic organisms. Background radiation in areas already zoned for the establishment of nuclear power plants was also measured. Finally, tests of coliform counts, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, and water hardness were performed.

Reference copy: Library of Marist College

****

Utah Lake Plankton Crop Estimation Incorporating ERTS - 1 Imagery (Grant no. GY-11530)

Brigham Young University
Provo, Utah 84601

June 1, 1974 - September 1, 1974

Participants:

Boyd J. Hanson*
Thomas A. Leslie, Jr.
Margaret Ann Murray
Karen Ann Roberts
Larry L. St. Clair
Thomas W. Toole
Mark C. Whiting

*Student Project Director

Samuel R. Rushforth, Faculty Advisor

Utah Lake, in Eastern Central Utah, is a shallow eutrophic lake unique for its high turbidity and large summer algal blooms. This aquatic environment has been disturbed drastically by municipal industrial and agricultural effluvium in recent years. The ecology of this lake will continue to be so affected in the future.

The project included quantitative and taxonomic studies of the phytoplankton. The effect of primary productivity on population size and species diversity of zooplanktonic and pelagic organisms was also studied. This information was correlated with concurrent waterchemical data.

Samples were taken along transects chosen to represent subenvironments within the lake. Collections were made weekly with intensive sampling on those days when the ERTS-1 satellite passes over Utah Lake. Holoplankton samples were collected and subjected to microscopic, quantitative, and qualitative analysis. The lake water was sampled at varying depths and tested using standard water chemical methods.

The information collected during this study will be valuable for three basic reasons:(1) it will enhance the interpretation of existing and future NASA Earth Resources Technology Satellite-1 (ERTS -1) imagery data; (2) the proposed project was designed to provide the first confident quantitative estimations of the standing holoplankton crop of Utah Lake; (3) it will provide baseline data for future land use planning and environmental impact studies.

Reference copy: Library of Brigham Young University

****

Use of Radiotracer Techniques to Study Ecological and Physiological Behavior of Cadmium (Grant no. GY-11427)

Purdue University
Lafayette, Indiana 47907

May 13, 1974 - August 2, 1974

Participants:

Laura A. Arnold*
William M. Edmonds
David F. Frankenhauser
Terri J. Holderman
Arden D. Hoover

Cathleen A. Kien
Leonard Kong
David M. Miller
James P. Swigert
Mary A. Turner

*Student Project Director

Alan McIntosh, Faculty Advisor

Cadmium is widely regarded as a dangerous environmental contaminant. The Environmental Protection Agency recently listed cadmium among eight toxic substances considered to be of most concern in the environment. Numerous laboratory studies have demonstrated that low levels of cadmium are toxic to many organisms. Several aspects of cadmium behavior have received little attention, however. This study dealt with two such aspects.

The effect of carrier and metallothionien induction on the distribution of ^{115m}Cd in the rat - this study consisted of three separate experiments. Only two were originally proposed, a single dose study and a multiple dose study, both dealing with the effect of cadmium on the distribution of ^{115m}Cd in the rat. A third experiment involving metallothionein was devised to make use of numerous extra animals. Conclusions have been drawn from the data yielded by each of the three experiments, and an attempt to interpret these conclusions is now in progress. In the single dose study, the data indicate that different levels of carrier do influence the distribution of cadmium in the rate, particularly in the liver and kidney. The spleen and pancreas appeared to be generally unaffected. Similar conclusions were reached in the multiple dose study. The level of carrier caused a significant difference between the same organs of animals receiving different amounts of carrier. In the third experiment, it was found that the presumed varying levels of metallothionein in the animal system produced a subtle set of interactions between organs which were detected by the Pearson correlation analysis as positive and negative correlations between specific organ pairs.

The behavior of ^{109}Cd in terrestrial ecosystem models - after the second application of the labelled cadmium, samples were taken at 24 hours and then subsequently at 48 hour intervals for the following six days. On days in which samples were not taken, one liter of distilled water was applied as a simulated rainfall to each terrestrial ecosystem model. Two cores of soil were taken at random from each terrestrial ecosystem model per sampling period, rather than only one as in the first half of the experiment. Percent moisture content of the soil samples was also determined during the second half of the experiment.

It appears from preliminary interpretation of the results that soil type influenced the distribution of Cd in the ecosystems. Plant cover was also found to influence the distribution whereas the chemical form did not. In the earthworm study it appears that both soil type and chemical form influence the uptake of cadmium by earthworms.

Reference copy: Purdue University Library

****

☆ U. S. GOVERNMENT PRINTING OFFICE : 1976 597-466/6120